Subterranea

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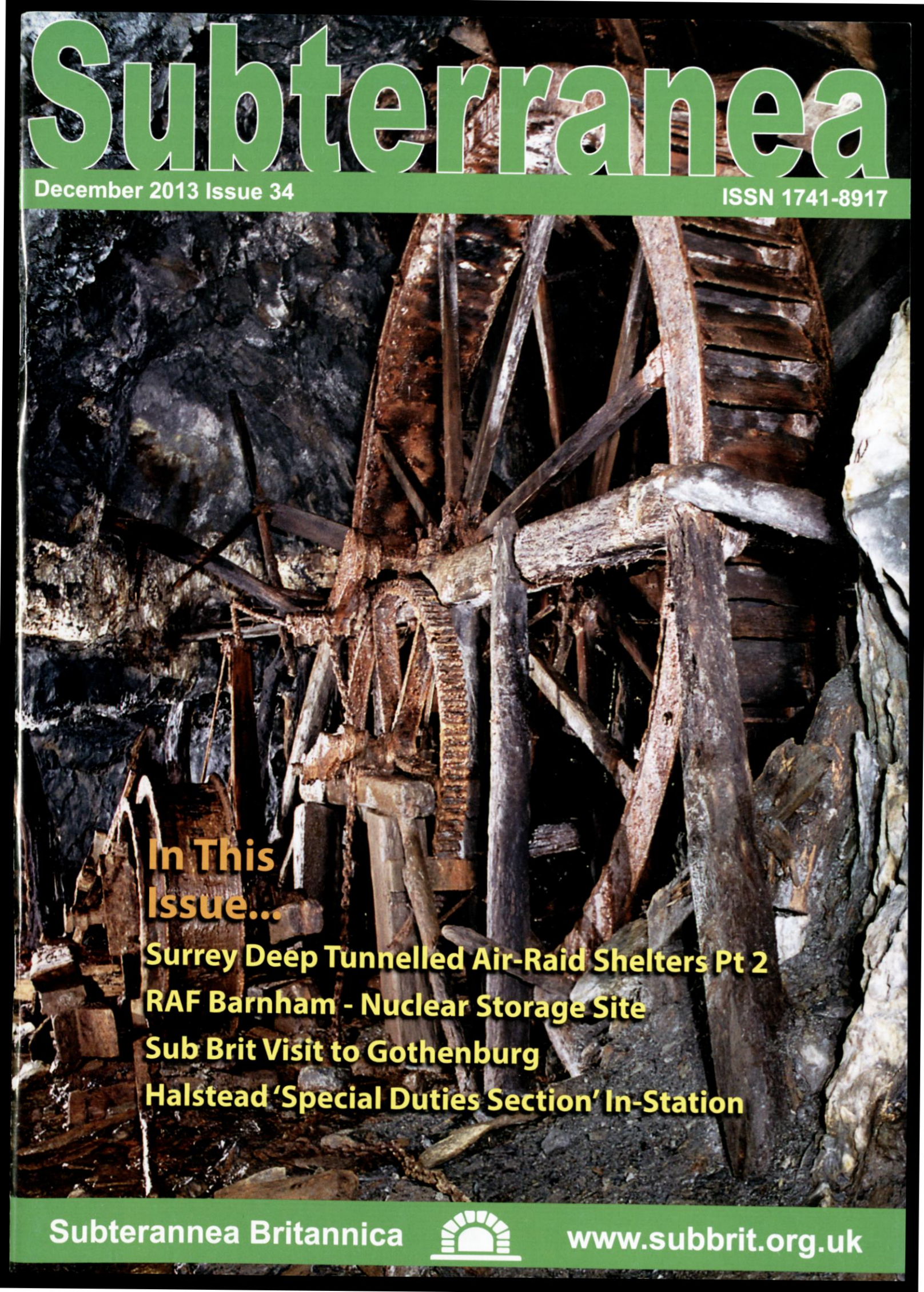

In This Issue...

Surrey Deep Tunnelled Air-Raid Shelters Pt 2

RAF Barnham - Nuclear Storage Site

Sub Brit Visit to Gothenburg

Halstead 'Special Duties Section' In-Station

Subterannea Britannica

www.subbrit.org.uk

Subterranea Britannica is a society devoted to the study of man-made and man-used underground structures and the archaeology of the Cold War. The society is open to all and its membership includes all walks of life. Members are invited to contribute to this magazine even if this just means sending very welcome snippets from newspapers and magazines.

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Front cover photo: Ystrad Einon Copper mine worked a NE-SW lode which is unusual in mid-Wales and is largely restricted to the Dovey estuary. Development of the mine below adit level did not start until the late 19th century with the sinking of a winze to the 12 fathom level in 1871. A 16' diameter underground waterwheel was installed for pumping and lifting; this allowed the mine to be deepened by another 12 fathoms. Photo Nick Catford

Back page upper: Gothenburg weekend attendees gather round a Saab Viggen fighter jet in the underground hangars at Säve. The Chairman is in the driving seat. Photo Lars Hansson

Back page lower: The daunting entrance to most northern of three explosives storage buildings at the very top of the loop of the road at RAF Barnham. These buildings were designed to handle the 24ft long, 10,000lb Blue Danube freefall atomic bomb, Britain's first operational nuclear weapon, later the smaller Red Beard tactical weapon. This shot, from nearly a decade ago, shows how the vegetation has been reclaiming the 23 acres of land that the nuclear site occupied. Nature has even begun to take apart the vast drive through gantry structure where the 10 ton crane used to handle the large weapons. The corrosion of the metal stringers inside the beams has rusted, cracking the surrounding concrete away. Photo Nick Catford

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Newsletters of Subterranea Britannica are published by the committee of Subterranea Britannica. Original articles, book reviews, press cuttings, extracts from books and journals, letters to the Editor etc are welcome. However the Editor reserves the right not to publish material without giving a reason.

The committee of Subterranea Britannica and the Editor do not necessarily agree with any views expressed and cannot always check the accuracy of any material sent in.

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Chairman's Welcome

Martin Dixon

2013 seems to have shot by but I hope, like me, that you have managed to visit some sites from your 'wish list' and had fun while studying and visiting the underground.

Since the last edition of Subterranea we've introduced a new online Members' database ('MySubBrit') and that triggered me to write a few words about Sub Brit and digital media in general. We were (relatively speaking) very early into the online world, thanks to efforts by "wired" members, including Mark Bennett, Richard Lamont and Gavin Saxby. Today our Webmaster is Richard Seabrook and Nick Catford manages the content on our main site. In parallel, James Buller looks after Social Media for us.

The Sub Brit Questionnaire in 2011 showed that the website was important to 89 percent of the membership (second only to *Subterranea*), with 86 percent of members 'very satisfied' or 'satisfied'. Since Richard Seabrook became our Webmaster he has revamped the front end of our site to add a GIS (Geographic Information System) and integrated the different site record databases. We have also added new features such as the Sub Brit Collection and the Sub Brit Shop. The latter is very successful in selling our own publications plus (through Amazon) more general works.

Most recently Richard implemented MySubBrit which cut over very smoothly in September. One great advantage already realised is that members can update their own records (such as change of postal or email address). Another benefit is that we have been able to automate our Gift Aid claims. We have also launched the online Event booking system, which you can currently use to book your attendance at the Spring Meeting in April next year. The next step is to work on the development of a Members' forum.

Our early lead in building a website has an element of disadvantage as it was designed before CMSs (Content Management Systems) were commonplace. To make future additions easier we need to implement a CMS and transfer our site records across. This is quite a major task, but once achieved it will be much easier for members and editors to upload new site content and update existing site records.

As well as being valuable to members, our website is also highly regarded by the public generally and is used by groups such as English Heritage as a valuable resource. Although the virtual world can never quite match the excitement of a hands-on experience, our website attracts around half a million unique visitors a year, accessing about four million pages of information. Our growing social media have almost 3,500 followers – a reach well beyond our own membership.

If you have the skills to help support and develop our digital future, please contact Richard at webmaster@subbrit.org.uk.

Finally, we are in the process of arranging what we hope will be a special celebration for our 40th anniversary next year. We'll announce details as soon as they are confirmed but we're looking at an underground venue with a buffet meal and a special guest or two. Until then please find a celebratory car sticker enclosed as an early birthday present!

Chairman@subbrit.org.uk

Subterranea Britannica

Notice of Annual General Meeting 2014

The AGM will be held on Saturday 26 April 2014, commencing at 10.00am at the Royal School of Mines, London, in association with the Spring Meeting

***

Documents for the AGM will be available on our web site at www.subbrit.org.uk at least 28 days in advance of the meeting. A note will be sent to the 'announce' email list to advise when such documents are available

Those members who have registered to receive documents by post will be sent them when they become available.

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Minutes of the AGM 2013 are printed in this issue of Subterranea

SUBTERRANEA BRITANNICA DIARY

Summary of Forthcoming Events 2014

Sub Brit specific events 2014

18 January SB Committee meeting

1 March Copy deadline for *Subterranea* 35

Mid-April *Subterranea* 35 published

26 April SB Spring meeting and AGM, London (programme & booking form enclosed)

May (date tbc) Paddock Standby Cabinet War Room Open Day

9 - 12 May SB Visits - Trip to Prague (see flyer)

14 June SB Committee meeting

1 July Copy deadline for *Subterranea* 36

Mid-August *Subterranea* 36 published

11 - 12 October SB Autumn meeting & Visits Day, Newcastle

For more up-to-date information, please visit www.subbrit.co.uk/events or contact the Society concerned

If you know of other relevant events run by other societies, please let us know so that they can be advertised in the next edition and on the website

Other underground-related events 2014

Until 5 January Poster Art 150 London Underground's Greatest Designs at London Transport Museum www.ltmuseum.co.uk

14 January, 11 February, 11 March London Underground Railway Society talks lurs.org.uk/meetings.htm

19 February GLIAS talk "Medieval Mills in Greenwich" www.glias.org.uk/gliasdiary.html

12 April SERIAC conference, Croydon

12 - 27 July NAMHO Conference / Visits 2014 Bangor, Gwynedd

September (tbc) SFES weekend Congress, France

11 - 14 September Heritage Open Days www.heritageopendays.org.uk

20 - 21 September London Open House www.londonopenhouse.org.uk

September (tbc) Doors Open Days, Wales www.opendoorsdays.org.uk

September (tbc) Doors Open Days, Scotland www.doorsopendays.org.uk

September (tbc) European Heritage Open Days, Northern Ireland www.discovernorthernireland.com/niea/ehod.aspx

Spring Meeting 2014

Saturday 26 April, commencing at 10.25am

Royal School of Mines, London, SW7 2BP

***

There will be the usual mix of interesting illustrated talks, including:
Nick Catford on Underground London (part two)
Andy Prada (Durand Group) presenting on the WWI tunnels of Loos Salient
Paul Sowan covering the mines and quarries of East Surrey and
Ben Nithsdale will describe the history of London's sewers
along with Members' contributions and a chance to meet and mingle with fellow enthusiasts

***

A paper Booking Form is enclosed with this issue of *Subterranea*

The programme & booking form will also be on our website

Please put the date in your 2014 diary now!

Annual General Meeting 2013 - Minutes

20 April 2013

The meeting was opened by the Chairman, Martin Dixon, who welcomed all those attending – especially new members. 93 members were present.

1. Apologies were received from Mike Norris, Roger Gosling, Kit Derrick and Steve Underwood.
2. The motion to adopt the Minutes of AGM of 21 April 2012 was proposed by Andrew Smith, seconded by Hugh Ainsley, and passed "nem con".
3. The Chairman highlighted some of the key achievements of the past twelve months, as recorded in the Annual Report (which had been circulated in advance of the meeting):
   * A growing presence on social networks to complement members' email lists
   * Three excellent editions of *Subterranea*
   * Grant aid (using Gift Aid income) for underground-related projects
   * Spring and Autumn meetings, the latter including a day of visits in Liverpool
   * Long weekends in Jersey and Sussex
   * A range of visits, representing sites of many types and ages.
   * Expansion of our website to include a shop and images from the Sub Brit collection
   * Opening of sites such as Paddock and Cuckfield ROC post to the public
   * Collaboration with the London Borough of Lambeth in erecting a display board at Clapham South underground station
   * Fieldwork on underground sites across the country.

   The Chairman gave thanks to all those who had contributed to these and other activities and gave particular thanks to the Committee for their hard work and support.

   Looking forward, he said that 2013 had started with a record number of planned visits - a sign of an active membership. 2014 would mark the 40th anniversary of Subterranea Britannica's foundation and he invited suggestions for events to mark this milestone.
4. The Chairman reported that the Sub Brit accounts had been independently examined, and lodged at Companies House and with the Charity Commissioners. They had also been circulated/made available to members in advance of the AGM.
5. A motion that "that annual subscriptions for UK members should be increased to £21, and for overseas members to £31, with effect from 2014" was introduced by the Chairman, who explained the reasons for the proposed increase, which included higher production costs for *Subterranea* and increases in postal charges. Richard Savage asked whether the increase would be sufficient, and the Chairman said that the committee were confident that it would be. John Burgess commented that the subscription would represent very good value for money in comparison with many other organisations. Linda Dixon reported that the committee were currently obtaining alternative quotations for the printing of *Subterranea*, to ensure that prices remained competitive. The motion to increase subscriptions was then passed "nem con", with two abstentions.
6. A motion that "nominations for election be considered "en bloc" was proposed by Paul Sowan, seconded by John Burgess, and passed "nem con".
7. A motion to elect the following Officers and Committee for 2013/2014 was passed "nem con".
   - Martin Dixon (Chairman)
   - Nick Catford (Membership Secretary)
   - Linda Dixon (Vice Chairman)
   - Tony Radstone (Treasurer)
   - Roger Starling (Secretary)
   - Chris Rayner (Member)
   - Mark Russell (Member)
   - Richard Seabrook (Member)
   - Andrew Smith (Member)
   - Paul Sowan (Member)
   - Bob Templeman (Member)
   - Richard West (Member)

The meeting closed at 10.25am.

NEWS

Miscellany compiled by Paul Sowan and Nick Catford

NEWS – ARCHAEOLOGY

Roman drainage culvert excavated in the City of London

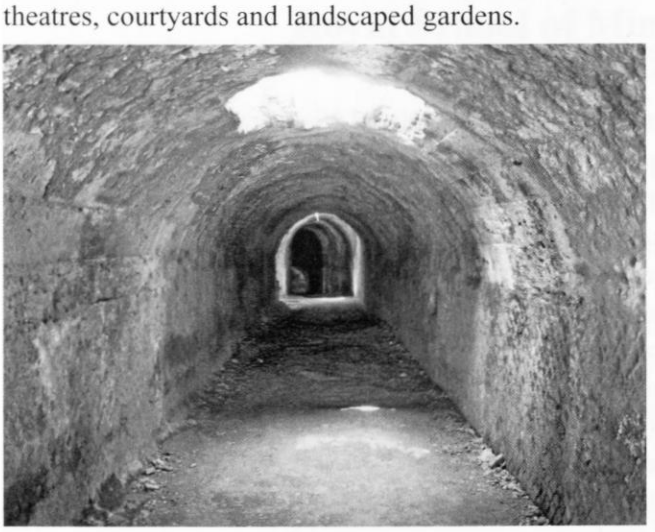
A Museum of London Archaeology Service team has excavated a site in Monument Street and reported on a Roman era tunnel, of which some 13 metres survive and were accessible via a vertical entrance shaft 0.9 metres square and 3.36 metres deep. The culvert, which included two silt traps, was 0.65 metres wide, and from 1.3 to 1.82 metres high, lined mostly in Roman brick.

SOURCE: BLAIR, Ian, and David SANKEY, 2007, A Roman drainage culvert, Great Fire destruction debris and other evidence from hillside sites northeast of London Bridge. Excavations at Monument House and 13 – 21 Eastcheap, City of London. London: *Museum of London Archaeology Service Archaeology Study Series* 17: xii + 79pp [ISBN 978-1-901992-69-4]

Archaeologists discover hidden tunnel beneath Hadrian's Villa

Italian archaeologists have discovered a hidden tunnel beneath Hadrian's Villa near Rome, part of a network of galleries and passageways that would have been used by slaves to discreetly service the sprawling imperial palace. The newly-found tunnel was large enough to have taken carts and wagons, which would have ferried food, firewood and other goods from one part of the sprawling palace to another.

The villa, at Tivoli, about 20 miles east of Rome, was built by Hadrian in the 2nd century AD and was the largest ever constructed in the Roman period. It covered around 250 acres and consisted of more than 30 major buildings. Although known as a villa, it was in fact a vast country estate which consisted of palaces, libraries, heated baths, theatres, courtyards and landscaped gardens.



Hadrian's tunnel after clearance of debris

There were outdoor ornamental pools adorned with green marble crocodiles, as well as a perfectly round, artificial island in the middle of a pond. Beneath the complex were more than two miles of tunnels which would have enabled slaves to move from the basement of one building to another without being seen by the emperor, his family and imperial dignitaries.

Many of the tunnels have been known about for decades but this one is far larger than the rest. It was discovered after archaeologists working at the site stumbled upon a small hole in the ground, hidden by bushes and brambles, which led to the main gallery. Around 10ft wide, it runs in a northeasterly direction and then switches towards the south. Although much of it is blocked by debris that has accumulated over the centuries, Heritage officials are hoping to organise public tours of the tunnels once the debris has been cleared.

SOURCE: *Daily Telegraph,* 20 August 2013.

NEWS – CONSERVATION AND HERITAGE

All change (again) for English Heritage

Hard on the heels of the transformation of British Waterways into a charity independent of central government, the present administration now proposes to split English Heritage into two parts, to operate independently under new names. Management of the 423 historic properties in English Heritage ownership, referred to as the National Heritage Collection, is to be transferred to a new self-financing independent charity, relying heavily on volunteers for its operation (as currently does the National Trust). The statutory duties of English Heritage, which include for example the scheduling of Ancient Monuments and related administration, will be assumed by a new body known provisionally as the National Heritage Protection Service.

Meanwhile, English Heritage receives a further cut (this time of 10 percent) in government funding. The National Heritage Collection will start with £80m but will be expected thereafter to raise its own income. The target date for all these changes is 1 April 2015.

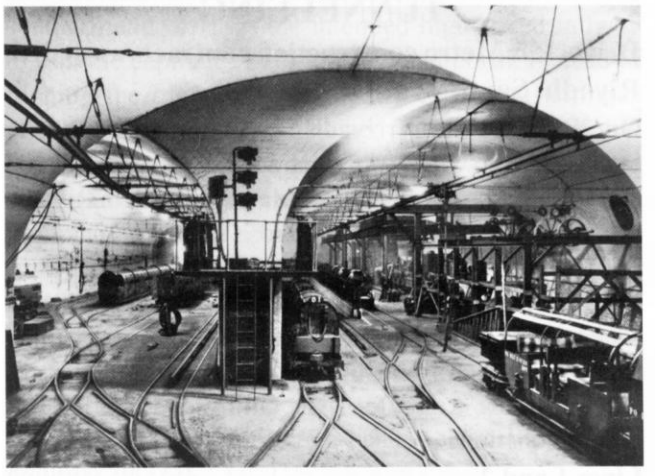
SOURCE: PALMER, Marilyn, 2013, Drastic development for English Heritage. *Industrial Archaeology News* 166.

Plans to open sections of London's Mail Rail to the public

The British Postal Museum & Archive (BPMA) has submitted a planning application for the development of a short section of the old Post Office Underground Railway (Mail Rail). The planning application, made to the London Borough of Islington, seeks approval for the repurposing of ground-level workshops, the car maintenance depot and part of the underground tunnel network around Mount Pleasant, home of the world's oldest mail centre, allowing public access to the site for the first time in its history.

The application forms part of the BPMA's major project to deliver a new postal museum and archive for the nation, and follows an application submitted by Royal Mail for the wider development of some parts of the Mount

Pleasant site that are no longer needed for its operations. Brought into service in 1927 and in constant use until 2003, Mail Rail is the world's only purpose-built underground mail transit system. A narrow-gauge railway, the electrified, driverless cars were used to convey mail across London from Whitechapel to Paddington via six stations. At its peak, the network operated for 22 hours a day, during which time it would carry up to four million letters.



Mount Pleasant depot

Under the BPMA's proposals, this exciting new development will showcase this unique and important engineering and transport system. Exhibition space will highlight the industrial heritage of the railway and how the Mail Rail system operated, relating it to the wider story of moving the mail by rail and the links it provided to the rest of the country and beyond. In addition, the development will include an event space for functions and conferences and a Family Zone for children and parents/guardians that will be available for all members of the community.

Planning permission will mark a significant step towards the BPMA's goal of opening up a new museum and visitor experience at Mount Pleasant, with plans for a new museum at nearby Calthorpe House previously approved in July 2012. A major fundraising campaign is currently under way to secure the shortfall in funding for this project.

SOURCE: British Postal Museum press release, 10 October 2013.

European Industrial Heritage Year 2015

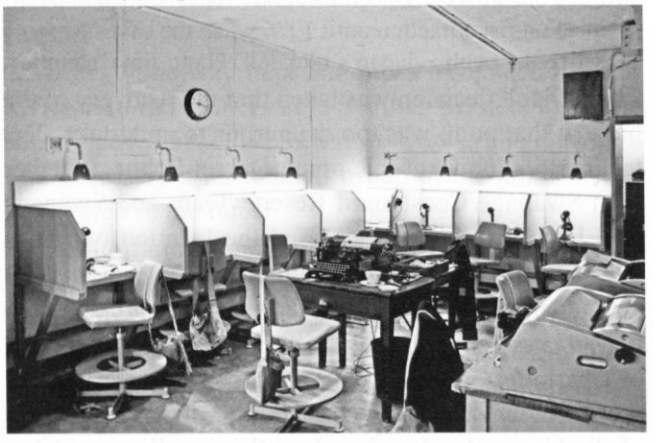
In 1975 many UK voluntary organisations played a part in the celebration of European Architectural Heritage Year. Forty years on, reflecting the growing appreciation that our industrial development has been of as much national importance as, say, Dover Castle, Hadrian's Wall and Stonehenge, the industrial achievements of Europe (both the mainland and the offshore parts, the latter including the British Isles) are to be celebrated in 2015.

Subterranea Britannica was but a year old, 40 years ago, but has from the outset enjoyed very close links with other European countries, commencing in 1974 with France and Germany. Since then we have visited mines (abandoned and working), above and below ground, throughout the UK and several mainland European countries, most notably in Belgium, France, the Netherlands and Sweden. Indeed our present Chair and Vice Chair were photographed, during the visit based in Maastricht, either side of the Belgian/Dutch border in an underground quarry tunnel near that city. It would be very appropriate for our Society to do 'something special' in 2015.

SOURCE: SAULTER, Paul, 2013, 2015: what will we do for European Industrial Heritage Year? *Industrial Archaeology News* 166.

Gravesend Civil Defence bunker Listed, Kent

The Gravesend Civil Defence bunker, overlooking the south bank of the Thames, was built in 1954, so an early Cold War monument. It was in use until 1968, and would have accommodated 35 staff had it been needed. It is restored and open to the public, and has now been Listed Grade II by English Heritage.



Signals room in the Gravesend bunker. Photo David Jackson

SOURCES: ANON, 2013, Bond's warehouse and Cold War bunker protected with heritage status. *Daily Telegraph*, 20 September, 2013; WALKER, Peter, 2013, Loved, loathed, listed: postwar architecture wins protection. *The Guardian*, 20 September 2013.

NEWS – HEALTH & SAFETY

Death of woman in former quarry cave

A woman has died after becoming trapped in a Dorset sea cave. A coastguard rescue team was called to Tilly Whim Caves in Durlston, near Swanage, on Saturday afternoon 2 November, after a man swimming with her raised the alarm. He was winched to safety but the woman, aged 30, had become trapped in the caves at sea level. By the time rescuers reached her she had died. The man, 31, was unhurt. Rescuers were unable to retrieve the woman's body as it was deemed "too dangerous".

Portland Coastguard said the weather conditions were "horrendous" with gale force winds and high tide making the operation extremely difficult. The only ways in to the cave were underwater, or though a narrow blow hole at the top of the cave.

The rescue was considered to be at the very edge of the crew's technical capability. With the light failing and high tide approaching, a final risk assessment was undertaken by the office in charge and a decision was made to deploy.

A member of the crew showed exceptional courage and entered the cave through the blow hole. On entering the cave it became apparent that the casualty had sadly succumbed.

Tilly Whim Caves were limestone quarries that were worked during the eighteenth century. They were a popular local tourist attraction until 1976 when the caves were closed to the public, due to a rock fall. Photo Jim Champion

The difficult decision was taken that the recovery of the body at that point was too dangerous to undertake. The teams stood down at this point. Dorset Police, together with Swanage Coastguard Rescue Team and Swanage RNLI inshore lifeboat accessed the location two days later and conducted a thorough search but the missing swimmer has not been located and inquiries are ongoing.

It was later reported that the recovered body was that of Charlotte Furness-Smith, a Royal Navy recruitment specialist, who had been 'coasteering' – the extreme sport of climbing and swimming along the coastline – with her brother Alex near Swanage, when she was swept into the Tilly Whim caves by crashing waves.

SOURCE: *BBC News – Dorset,* 3 & 5 November 2013; *Daily Telegraph,* 9 November 2103

Two-mile drug-smuggling tunnel between Mexico and USA

A U.S. Homeland Security agent enters the interior of a drug tunnel between Mexico and the United States

A drugs smugglers' tunnel reported to be 2.4 miles long under the border from a warehouse in Tijuana (Mexico) to San Diego (California, USA) has been closed by US authorities. The tunnel was 10.7 metres (35 feet) below ground, 0.9 metres wide and 1.2 metres high, and was equipped with lighting and ventilation. As a result of the US action eight kg of marijuana and 147 kg of cocaine were seized. A similar tunnel found and destroyed about two years ago resulted in the confiscation of 32 tonnes of marijuana. Since 2008 more than 75 tunnels have been found.

SOURCE: TUCKMAN, Jo, 2013, US shuts drug smugglers' 'super tunnel'. *The Guardian*, 2 November 2013.

NEWS – TUNNELS AND TUNNELLING

Driverless Metro construction contracts awarded, Riyadh, Saudi Arabia

On 29 July 2013 Arriyadh Development Authority announced the winners of contracts for the construction of a 176 km six-line driverless Metro network in Riyadh. The overall budget for the Metro is €16.3bn, making it one of the world's largest public infrastructure projects. Design work is to begin immediately, with construction scheduled to start in the first quarter of 2014 for opening in 2018. The 87 stations will be air-conditioned, and the trains will offer first, family and single-class accommodation.

Lines 1 and 2

The BACS consortium led by Bechtel and including Almabani General Contractors, Consolidated Contractors Company and Siemens is to design and build lines 1 and 2, totalling 63.3 km. The contract is valued at US$9.45bn. Much of the north-south Line 1 will be underground, while east-west Line 2 will be mostly elevated in a road median strip.

Line 3

The ArRiyadh New Mobility consortium has been awarded a US$5.21bn contract to design and build Line 3, which will be the longest line at 40.7 km and have 22 stations. The consortium comprises two groups: electrical and mechanical equipment from Ansaldo STS and Bombardier Transportation; Infrastructure from Salini-Impregilo, Larsen & Toubro, and Nesma.

The consortium is led by Ansaldo STS, with a US$680m share of the contract that includes provision of automation systems, CBTC, third-rail power supplies, the control centre, telecoms and fitting-out the depots. Bombardier Transportation's US$383m share of the contract includes the supply of 47 two-car driverless Innovia Metro 300 trains with Mitrac traction equipment.

Lines 4, 5 and 6

The FAST consortium led by Spanish construction group FCC and including Samsung C&T, Alstom, Strukton, Freyssinet Saudi Arabia, Typsa and Setec is to build lines 4, 5 and 6 for US$7.82bn. The contract covers the design and construction of three lines totalling 64.6 km. This includes 25 stations, 29.8 km of viaduct and 8.2 km at grade, with three tunnel-boring machines to be used to build the 26.6 km of the lines in 10m diameter tunnel.

Alstom's €1.2bn share of the contract includes supplying 69 two-car Metropolis automated train sets about 36 m long and 2710 mm wide, along with Urbalis signalling,

Appitrack mechanised track-laying technology and HESOP substations which allow regenerated electricity to be returned to the grid.

SOURCE: *Railway Gazette* online, 29 July 2013

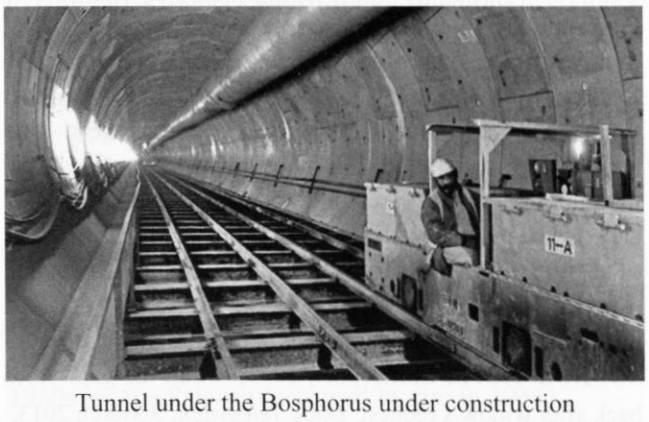
Proposed tunnel line for HS2 from Midlands to London

Lords Berkeley and Bradshaw have proposed a variant and subterranean route through north London for the southern end of HS2, the intended high-speed railway to link the capital to the Midlands and north. Instead of running the trains into an already congested terminus at Euston, they have suggested the new line should run in a new twin-bore tunnel below both Euston and King's Cross / St Pancras stations, with new subsurface platforms at each. The new tunnels would run from Old Oak Common eastwards to connect with the existing HS1 line (Channel Tunnel Rail Link) between St. Pancras and Stratford, allowing through-running between the Midlands, east Kent, and mainland Europe if required.

SOURCE: ANON, 2013, 'Euston Cross' proposal aired for HS2. Railway lords' HS2 cross-London alternative. *Modern Railways* 70(775).

A tunnel now links Turkey-in-Europe to Asiatic Turkey

The world's deepest under-sea tunnel was opened under the Bosphorus on 29 October 2013, linking the two parts of Istanbul, the western part geographically in Europe and the eastern part in Asia. The new immersed tube rail tunnel, called the Marmaray tunnel after the Sea of Marmara, is eight and a half miles long, and runs 56 metres (184 feet) below the waves. It will supposedly withstand earthquakes up to magnitude 9. The timing of the opening was chosen to coincide with the 90th anniversary of the formation of the modern Turkish republic, although further work remains to be done before it is opened to traffic. The link was first suggested in 1860.



Tunnel under the Bosphorus under construction

The total population of the city is 15 million, of whom one and a half million people are expected to travel through the tunnel each day. With a crossing time of four minutes, it will be very much faster than the existing ferries.

SOURCE: LETSCH, Constanze, 2013, After 150-year wait, Istanbul tunnel joins Europe and Asia. $ 4 bn Concerns over safety of tunnel in earthquake zone. *The Guardian*, 30 October 2013, page 19.

Work starts on repairing collapsed Liverpool Overhead Railway tunnel

Work started in early October on repairing the tunnel in the Dingle which collapsed beneath local homes

The first phase of the work was undertaken by specialist engineering firm SES Contractors who were appointed after the city council brokered a deal resolving legal issues. It involved surveying and testing the tunnel from its entrance to the point where it collapsed and was completed in two weeks.

The tunnel, at the site of the old Dingle Station on the Liverpool Overhead Railway, collapsed in July 2012. Eleven properties were evacuated – eight in Sundridge Street, one in Toxteth Grove and two in Dingle Grove. [see *Subterranea* 31, Dec 2012, page 36. *Ed.*]

SOURCE: *Liverpool Echo,* 7 October 2013

Bat flaps used to help clear Galashiels railway tunnel

A series of one-way flaps and pipes have been fitted to a Victorian rail tunnel in the Scottish Borders to enable bats to leave ahead of renovation works. The operation was necessary after a small group of the animals was discovered in the tunnel.

A multi-million pound project is currently under way to reopen a rail link between the Borders and Edinburgh. The work to let the bats leave the 165-year-old tunnel was carried out under licence from Scottish Natural Heritage. Although no breeding or hibernation roosts were discovered in the tunnel, some Soprano pipistrelle and Myotis bats were found to be temporarily living in spaces such as those which were once used by railway workers seeking safety from passing trains. Now the one-way devices have been put in place to allow the bats to move out.

Galashiels tunnel with recently installed lighting

A small number are already using bat boxes which have been installed in nearby trees to provide alternative roost sites. Ecologist Reuben Singleton, working with IKM Consulting, said: "Our initial surveys showed that a small number of bats were leaving the tunnel at dusk and re-entering it at dawn."

Network Rail's project director Hugh Wark said it was committed to protecting local species as works progress. "Sometimes this means relocating local wildlife, and in

doing so, it is essential that we work with ecology experts to do this correctly," he said.

SOURCE: *BBC News – South of Scotland*, 5 September 2013

Tunnelled replacement for the Hammersmith Flyover proposed, London

The mid 20th-century Hammersmith flyover is considered by many to be one of the leading eyesores of London (although arguably there is a more ugly one just east of Romford!). Despite recent expensive repairs, the elevated road is judged to be likely to become less than fit for use within 15 to 29 years. It is now considered to be unsustainable for continued service into the 21st century, and plans are in course of formulation, with the support of Hammersmith & Fulham Council, to replace it with a tunnel. Seoul (South Korea) has already engineered such a transformation, with an elevated roadway now replaced by a tunnel below a new city park. [Boston, USA, has one too! *Ed.*]

SOURCES: SYMES, Claire, 2013, Hammersmith 'flyunder' plans launched. *New Civil Engineer*, 9 May 2013; SPITTLES, David, 2013, Hammersmith says farewell to the flyover and hello to waterfront. *Evening Standard,* 24 April 2013.

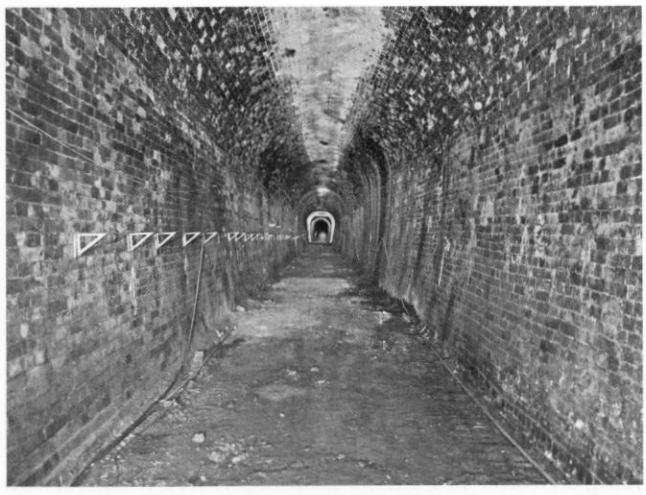
Historic Leicester railway tunnel opens to public

It has been disused, locked up and largely forgotten for decades. But now a mile-long railway tunnel deep beneath the streets of Leicester has been temporarily reopened for visitors.

The Glenfield Tunnel, built in 1829, was one of the world's first underground rail routes used by steam trains to carry coal from Northwest Leicestershire's pits to the city. It shut in the 1960s when British Rail sold it to Leicester City Council for £5. Now, the council has arranged for it to be reopened for visits guided by the Leicestershire Industrial History Society. The first took place on 12 September for a 20-strong group who were able to walk 100 metres into the tunnel from its entrance off Stephenson Court, Glenfield. The brick-lined structure re-emerges near Gilroes Cemetery but its other entrance has been bricked up.

Society secretary David Lyne led the group along the unlit stretch. He said: "We are very grateful to the council for letting us see this amazing piece of the city's industrial heritage. Most people have no idea it even exists." In the early 19th century, Leicester tended to buy its coal from Nottinghamshire and Derbyshire, despite there being coalfields in the county. That was because Derbyshire and Nottinghamshire had access to the canal network and northwest Leicestershire didn't. Pack horses brought the coal in from Whitwick but that was slow and more expensive.

The railway was built to address that; the price of coal in Leicester plummeted and the city's industry started to massively expand. This tunnel was very important for the city's industrial development. The construction of the tunnel took three years and cost more than £17,000 – well over its original £10,000 budget – because of



complications and because it was a relatively untested process. Renowned railway engineer George Stephenson was brought in to do the job.

The tours over several days have proved popular and have all been booked up. City mayor Sir Peter Soulsby, who joined the first group into the tunnel, said: "I must thank the Leicestershire Industrial History Society for doing these tours. Only in Leicester would we lock up and hide away such a wonderful feature." Sir Peter added that it might be possible to reopen the closed end of the tunnel and have it as a cycle path.

After 2000, a structural survey showed there was a danger of collapse because the tunnel was not designed to take the weight of the homes subsequently built above it. The city council spent £500,000 putting in concrete reinforcements.

SOURCE: *Leicester Mercury,* 13 September 2013

'Mind the gap' announcement reinstated at Embankment Station on the Underground, London

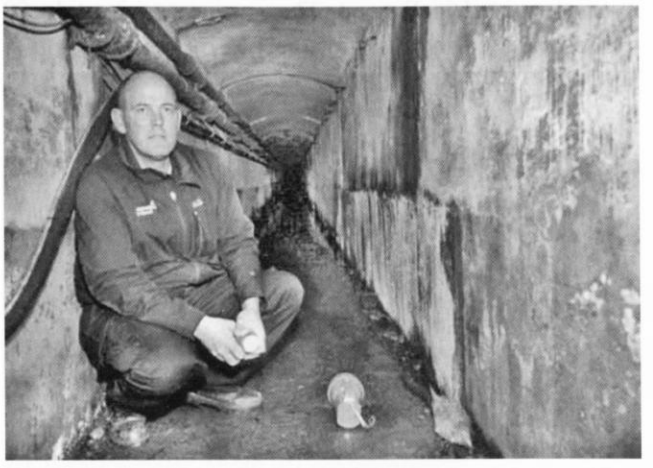
The recorded 'Mind the gap' announcement at London Underground stations where the station tunnel and platform is on a curve was recorded for LU by one Oswald Laurence (1933–2001), described as a 'horror actor' of the 1960s. The recording has been phased out across the Underground following upgrading works, and was last used on the northbound platform of the Northern Line at Embankment station. Laurence's widow's request that the announcement be restored at Embankment has been acceded to by LU staff. It appears that she is in the habit of visiting Embankment station in memory of Oswald, especially to hear his voice again. So, in case you doubted it, there are kind-hearted people in the LU management.

SOURCE: HOPE, Christopher, 2013, 'Mind the gap' voice back after widow's request. *Daily Telegraph*, 9 March 2013.

Plans to open historic tunnel under Sunderland's Roker Pier get lottery boost

Plans to offer public access to a tunnel running beneath historic Roker Pier have today taken a major step forward. Sunderland City Council has gained initial support from the Heritage Lottery Fund (HLF), paving the way for the development of a more detailed funding bid for £500,000 in

the next two years. It has also awarded the council £53,200 to develop plans for activities, conservation, management and maintenance, as well as further designs and interpretations. The announcement coincided with the 110th anniversary of the opening of the pier on 23 September 1903.



The Roker Pier tunnel has restricted headroom

The tunnel runs the entire length of the structure and helped carry gas pipes which powered the crane which turned its designs into a reality. It was later used to help the keeper reach the lighthouse in bad weather.

SOURCE: *Sunderland Echo,* 23 September 2013

Tunnel and Underground Construction Academy, Ilford

Britain has pioneered tunnelling worldwide from the days of Marc Brunel (a Frenchman!) and his Thames Tunnel onwards. British civil engineering companies such as Mott Macdonald of Croydon are still driving ever more ambitious tunnels throughout the world. Currently Crossrail's 36 miles of tunnels are steadily advancing, Hardly surprisingly, Britain is too a place where would-be tunnellers learn their craft, at an 'Academy' at Ilford, where a three-storey high 'shaft' on the surface is used to familiarise trainees with difficult situations in confined spaces. This can be made totally dark, filled with simulated smoke, etc, for practising rescues.

SOURCE: TOPHAM, Gwyn, 2013, UK tunnellers digging deep – and on a high. Huge Crossrail project is showcase for British claim to be world leaders in field. *The Guardian,* 24 August 2013.

Further news of access to Crystal Palace High-Level Station subway, London

The spectacular polychrome brick subway under Crystal Palace Parade in south London provided direct access for first-class passengers from the station (closed in the 1950s) to the Palace (destroyed by fire in 1936).

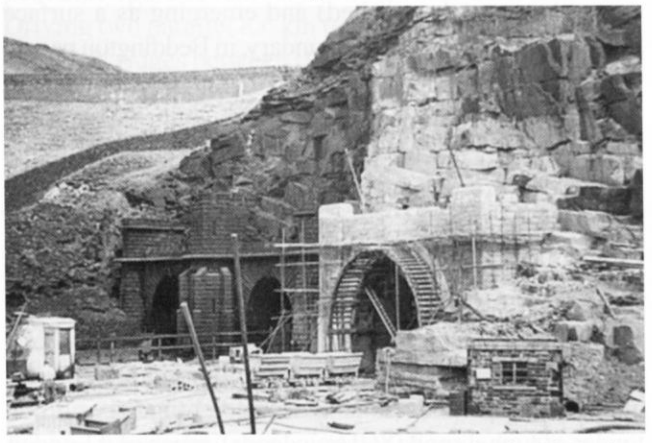
The Friends of the Subway group has spent two years on regaining public access, with encouraging advances. In May permission was granted for the demolition of a small masonry infill wall on the LB Southwark side of the Parade, the installation of a new steel gate at street level, and other works to facilitate access. For news of progress visit www.cpsubway.org.uk .

SOURCE: *Crystal Palace Foundation News* 53 (October 2013).

Woodhead tunnels to be sealed

Transport Minister Stephen Hammond has made a decision not to buy the Woodhead tunnels, between South Yorkshire and Derbyshire, from owners National Grid.

The original twin Woodhead tunnels were part of the Sheffield, Ashton-under-Lyne and Manchester Railway. Construction started in 1838 and 1,500 men were said to be employed on the tunnel at the construction's peak. The first tunnel opened in 1845 and the second in 1852. These tunnels were replaced by two new tunnels alongside in 1953 as part of the first British mainline railway to be electrified. National Grid bought the three-mile long Victorian tunnels in the 1960s and installed high voltage cables to transmit electricity.



The new Woodhead tunnel under construction in 1953; the Victorian single-bore tunnels are seen in the background
Photo Ben Brooksbank

The Woodhead line closed in 1981 and the new tunnel was also sold to the National Grid to install new cables, planning to abandon the Victorian tunnels when the cables needed renewing. National Grid began work on this project in 2007 and it is close to completion. Campaigners had hoped that the power cables could be moved into the older tunnels and trains returned to the newer tunnel to improve transport links between Manchester and Sheffield.

Mr Hammond said alternative schemes such as the Hope Valley route could accommodate the predicted growth in rail travel between Manchester and Sheffield. He said his decision did not rule out the possibility of reopening the Woodhead route to rail traffic in future but added "if an additional rail route was ever required, the best solution was most likely to be the construction of a new tunnel."

SOURCE: *BBC News - Sheffield & South Yorkshire,* 5 November 2013

The river Wandle underground and overground in Croydon, Greater London

Croydon, certainly established beside the springs feeding the river Wandle by Saxon times, extends southwards either side of what is now the A235 / A23 along a dry valley formerly known as Smitham Bottom, but now Brighton Road. The valley, also followed by the main railway lines to the south coast, was certainly eroded by water, when

the Wandle was rather longer and larger than it is now.

The main springs feeding the permanent river are close to the surviving ancient manor house, now usually known as the Old Palace (one of the several palaces of the Archbishops of Canterbury). After wet winters, at times of high groundwater levels, a 'bourne' or occasional surface stream flows along the valley, but since 1851 it has been confined to a brick culvert from Purley to and slightly beyond the Palace. Up until the 1960s the infant Wandle emerged into daylight from below the West Croydon to Sutton railway line and flowed through Wandle Park, feeding also an ornamental boating lake. But this further stretch of the watercourse was also culverted, about 1966, flowing next under the former gasworks (now demolished) and emerging as a surface stream only at the borough boundary, in Beddington parish.

This latest section of culvert (rectangular section concrete) has now been opened out again through the park. Wandle Park has had a £3.5m makeover, with the stream open to view again after nearly 50 years during which it was seen only by urban explorers.

CROYDON LB, 2013, Wandle Park's wonderful day, Crowds celebrate reopening in the sun. *Croydon Advertiser*, 12 July 2013

Crossrail tunnel spoil transferred to Essex

Excavation of the London Crossrail running tunnels and associated excavations will yield around six million tonnes of tunnel spoil (860 train loads), much of it London Clay. Material removed via the western portal at Old Oak Common is being sent by rail to Northfleet (Kent) and shipped from there to Wallasea Island (Essex) in the Thames Estuary, where it will by agreement with the Royal Society for the Protection of Birds form a wetland birds reserve. Spoil from the eastern portals of the tunnelling will also go to the same place, for the same purpose.

SOURCE: ANON, 2013, Millionth tonne of Crossrail spoil. *Modern Railways* 70(781).

The last two Crossrail TBMs are named and enter service, London

Eight tunnel-boring machines (TBMs) altogether are needed to drive the London Crossrail tunnels. Two new members of the team entered service at the end of Summer 2013. Their work commenced near the Olympic Park (now Queen Elizabeth Park) in east London. The thousand-tonne machines are named *Jessica* and *Ellie* after Olympic and Paralympic gold medallists Ennis and Simmonds.

The TBMs commenced work on 16 August at the Pudding Mill Lane portals, where in due course Crossrail trains will emerge into the Essex sunshine (or rain, or starlight, as the case may be) on the Great Eastern line for Stratford and Shenfield. *Jessica* is in the lead on the 2.7 km stretch (there are two parallel tunnels) to Stepney Green. She will then be redeployed to the SE branch of Crossrail to drive 900m tunnels between Limmo Peninsula and Victoria Dock.

At Stepney Green the westbound line crossover cavern, 40 metres below ground level, has now been completed. It will accommodate the junction, pointwork, and so forth, connecting to the Essex and Kent branches. TBMs *Elizabeth* and *Victoria* will pass through the cavern later in 2013 to continue tunnelling beyond. The two Crossrail crossover caverns are amongst the largest mined caverns ever excavated in Europe. They are approximately 50 metres long, 17 metres wide, and 15 metres high.

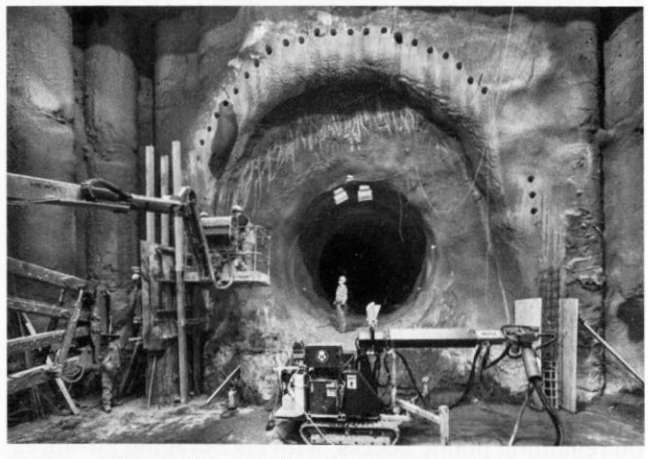
Jessica in place at the Pudding Mill Lane portal

TBMs *Mary* and *Sophia* have now reached the Woolwich station box (see *Subterranea* 32 (April 2013), page 29) and are now heading for the latest of a long line of Thames Tunnels. These two machines have to bore through water-bearing and permeable flinty chalk and gravel, which will be pumped out as a slurry via the Plumstead (Kent) portal. On the westwards drive, *Phyllis* and *Ada,* having burrowed past Tottenham Court Road, are fast approaching Farringdon.

SOURCE: HARVEY, Dan, 2013, *Jessica* and *Ellie* join the team. *Modern Railways* 70(781), page 98.

Two Crossrail TBMs to be abandoned underground near Farringdon, London

The two tunnel-boring machines *Phyllis* and *Ada* will be surplus to requirements when they have completed the two running tunnels from Royal Oak to Farringdon by the end of 2013. Extracting the two machines for possible use elsewhere seems likely to be difficult and uneconomically expensive.



Tunnelling and foundation works for the new Crossrail line into Bond Street

The rear parts, comprising crew quarters and facilities as well as a conveyor belt to remove material from the excavated tunnel face, can be dismantled and taken back along the tunnel to a convenient shaft and lifted out.

But the most economical option for the huge business ends of the machines seems to be to steer them off the tunnel alignment and abandon them entombed below the London streets. Just such an approach was taken, also, by Channel Tunnel TBMs, which remain under the sea bed. Trying to extract the cutting heads back along the way they have come would seriously delay continuing work on the completed tunnels, such as connections to station tunnels, and the installation of rails and signalling.

SOURCE; HARVEY, Dan, 2013, *Phyllis* and *Ada* to be buried alive. *Modern Railways* 70 (782), page 98.

Tunnelling developments on the Underground, London

Mike Chrimes, of the Institution of Civil Engineers, delivered the first talk of the day at our Autumn Day Conference in October at the Royal School of Mines. He is in charge of the ICE library in London, and thus in charge of a vast accumulation of historical records relating to civil engineering in general, and tunnelling in particular. He is a co-author / editor of the first two volumes of the *Biographical dictionary of civil engineers* issued in 2002 and 2008 covering the years 1500 to 1830, and 1830 to 1890.

Work on a third volume is well advanced. He also writes numerous short historical articles in the ICE's magazine, *New Civil Engineer*. One such article deals with the theme presented at the Day Conference, the first 150 years of the London Underground. The London Underground story commenced with the construction of the sub-surface Metropolitan Railway in the years 1859–1863. John Fowler (1817–1898) was the engineer who had formulated plans for this first underground line in the 1840s. Fowler's entry in the *Dictionary* occupies seven pages. This includes details for his engineering works from 1839 to 1897.

REFERENCE: CHRIMES, Mike, 2013, Underground revolution: London's early underground projects taught engineers valuable lessons about tunnelling. *New Civil Engineer,* 17 January 2013.

Contracts invited for building the Fehmarnbelt tunnel from Denmark to Germany

Currently the shortest rail and road route from Hamburg (Germany) to Copenhagen (Denmark) is via the car and train ferry from Puttgarden to Rødby (one of only three surviving passenger train ferries in Europe: the entire train travels across on the boat). Proposals to replace this short sea crossing by a fixed link have been discussed for some years. As with the English Channel, there have been arguments for and against a bridge or a tunnel. Long tunnels are always expensive for road traffic, as a result of the exhaust pollution and need for forced ventilation and elaborate fire precautions.

It appears that the dispute has, nevertheless, been resolved with a decision in favour of a 19-kilometre tunnel to convey a four-lane motorway and a double-track electrified railway under this arm of the Baltic Sea. The result is likely to be an immersed tube tunnel. UK contractors are amongst the nine concerns to have submitted proposals and estimated costings. Four construction contracts are expected to be signed in 2015,

SOURCE: LYNCH, Helen, 2013, Brits among bidders for Fehmarnbelt contracts. *New Civil Engineer*, 7 January 2013.

Long-running tunnelling for the west coast rail line, Sweden

Sweden's west coast line connects Copenhagen (Denmark) with Malmo and Gothenburg (Sweden), and Oslo (Norway). The first part is along relatively flat-lying land, whereas further north towards Gothenburg there is hillier terrain calling for numerous short tunnels to penetrate spurs of hard crystalline rocks such as gneiss. Driving two parallel 8.6 km tunnels through one of these hard rock ridges between Båstad and Förslöv is intended to allow doubling the line capacity. However, the work has to date taken 21 years, including stops and starts. The Hallandsås tunnels were in 2009 59 percent completed. The three phases of tunnelling (one abandoned after only 13 metres) penetrate the 10 km wide ridge of hard rock which is several tens of kilometres long. The present line diverts around the seaward end of the high ground. Hardness of the rock is not the sole difficulty. The material is inconsistent and highly variable, with fissured zones and deeply weathered crumbly material in places. The fracture zones admit vast quantities of groundwater, which severely hampers progress. Alongside the predominant gneiss there are zones of amphibolite, diabase and granite. Additionally to the inconsistent and unpredictable rock and the serious water problems, only a single tunnel-boring machine (TBM) can be used as a result of legal disputes and restrictions concerning groundwater.

When a length of one of the parallel tunnels has been bored, the TBM has to be removed and transferred to the other one for a period. But the initial tunnelling just inside the portals was done by drilling and blasting, giving an inverted U-section 7.2 metres wide, too narrow to allow the 9.4 metre diameter TBM to pass through. The machine, therefore, has to be manoeuvred into and out of the tunnels via vertical opening from the hillside above. Driving the tunnels started in 1992–95 and resumed again after a shut-down in 2003. Completion and commencement of traffic is now expected in 2015.

SOURCE: HANSFORD, Mark, 2009, Tunnelling special: Hallandsås tunnel. *New Civil Engineer*, 30 April 2009.

Problems with supply tunnels from Egypt to Gaza

Getting supplies into Gaza is difficult. Restrictions imposed by Israel mean the 1.7 million inhabitants are running short. The new regime in Egypt, from 3 July 2013, is adding to their difficulties by clamping down on under-border tunnels on which reliance has been placed for the last six years. At one point during that period there were thought to be around 1,000 tunnels, employing some 7,000 people. Eighty percent of these

subsurface routes are thought now to have been destroyed by Egyptian forces. Supplies of petrol from Israel are inadequate, and around twice the price paid for it from Egypt, when available.

SOURCE: SHERWOOD, Harriet, and Hazem BELOUSHA, 2013, Gaza low on supplies after tunnels shut. *The Guardian*, 20 July 2013.

NEWS – MILITARY AND DEFENCE

100th anniversary of the start of World War I

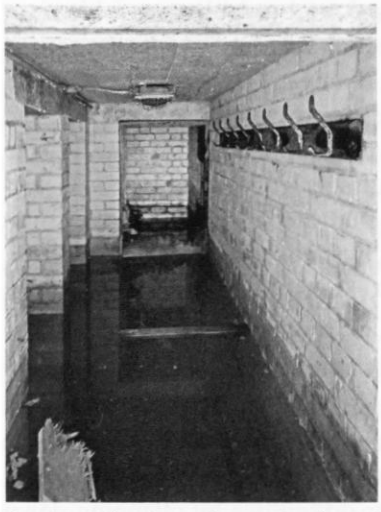
The centenary of the start of World War I falls due in 2014. Almost the whole issue of the latest issue of the *English Heritage Conservation Bulletin* is devoted to articles about the physical vestiges of that conflict and the UK's part in it, at home and abroad. Although there are articles on such topics as drill halls, coast defences, airfields, national munitions factories and so forth, there is no section specifically devoted to air-raid shelters, or to underground military stores.

The *Oxford English Dictionary* dates the first recorded use of the phrase 'air-raid shelter' to 1919, although such subterranean shelters as there were in the first war (mostly in the Channel ports and north Kent areas it seems) appear to have been reused existing excavations, rather than newly created voids. Even so, they were presumably fitted out at least with benches and rudimentary sanitary arrangements. And army supplies, including explosives if not munitions, were certainly stored underground at the Chislehurst 'Caves' and also allegedly in some of the 'caves' at Reigate.

SOURCE: ENGLISH HERITAGE, 2013, the first World War. *English Heritage Conservation Bulletin* 71 (Winter 2013).

Second World War bunker uncovered by sewage workers in Hampshire

Contractors had been digging a new sewage route to pump waste water between School Lane, Hamble and the Bursledon Waste Treatment Works, run by Southern Water, when they came across a red-brick bunker with concrete roof.



Looking along the main passageway. The entrance to the messenger's room and the defence officer's room are to the left with the toilet straight ahead. Photo from 4 Delivery Ltd

Archaeologists from Archaeology South-East were called in by contractors 4 Delivery Ltd the following day to record the structure but were unable to enter it for health and safety reasons as it was partially flooded. It was determined that the structure, on the former Hamble Airfield off Hamble Lane, is an airfield battle headquarters and of both local and national significance. They believe it had a messenger's room, a defence officer's room, an observation room, PBX room (telephone exchange) and toilet but, unlike most other airfield battle headquarters that are all built to a standard design, this one appears to have an additional room. Only two other battle headquarters at RAF Dale and RAF Barrow are known to have included this additional room.

Unfortunately residents and history enthusiasts will not be able to see the bunker as Southern Water have covered it over after its exact position was recorded. The alignment of the pipeline running through this area was however changed to ensure the structure was avoided and protected from groundwork.

SOURCE: *Southern Daily Echo,* 12 October 2013 and Archaeology South-East

Underground cold war bunker discovered in Colchester

On 8 August, contractors working in the grounds of Abbey House in Colchester had a big surprise – they discovered an underground corridor! After breaking through the wall to gain access they discovered that the corridor led into an underground chamber. In the other direction the corridor led to a bricked-in entrance in the cellar of the house. Archaeologists were called in to record and interpret the structure.

The wall of the structure was broken through to gain access

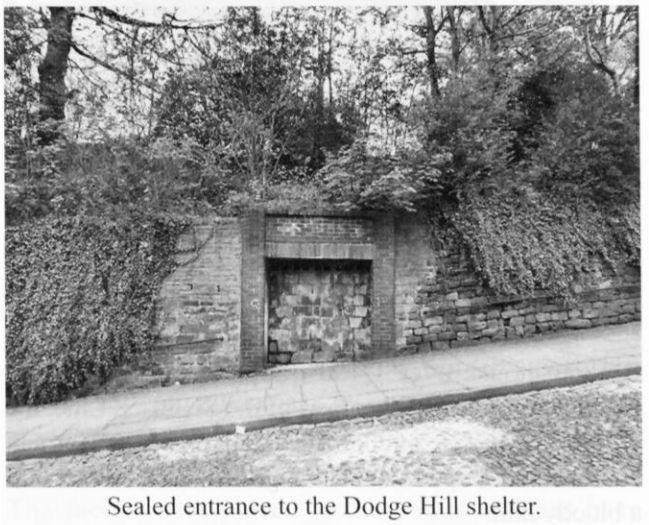
They came to the conclusion that it was an interesting example of modern military architecture. It may date to the Cold War/nuclear crisis era after WWII, and have been used as a crisis command and control bunker for the garrison commanders. A similar bunker survives in Beverley Road in Colchester. It is unlikely to be a WWII air-raid shelter, as these are usually narrower and include two long rows of seating. There is some faded graffiti on the walls, most of which appears to be in German. Unfortunately there are no surviving signs.

SOURCE: *The Colchester Archaeologist*, 14 August 2013

Two fires in two days in Stockport's Dodge Hill air-raid shelter

Twenty-five firefighters twice searched the labyrinth of tunnels in the Heaton Norris area of Stockport, after nearby residents spotted smoke. It is thought that the fires, which broke out on two consecutive evenings in late October, were started by people sneaking into the tunnels and exploring using light from a naked flame. A number of tea lights and candles were found in the underground network, which runs for 200 metres underneath the town.

Now fire-station watch commander Eamonn Lyons has issued a warning to stop people breaking into the shelters off Dodge Hill. He said: "These weren't big fires on this occasion but the way the air goes through the tunnels they can become very heavily smoke-logged and it can take a long time to clear it. When we arrive it is also unclear how big the fire is or if someone is trapped inside so we have to do a full search." Four crews attended the scene on each occasion after the fires broke out.



Sealed entrance to the Dodge Hill shelter.
Photo Gerald England

A council spokesman said: "The health and safety of borough residents is the main concern of the council and arrangements are being made to secure the site."

The Dodge Hill tunnels are carved into red sandstone and run under St Mary's Church in Heaton Norris. The tunnels were one of three air-raid shelters excavated in Stockport during the Second World War; the others are at Brinksway and Chestergate, which is now a tourist attraction. Dodge Hill, the smallest, was built to accommodate 2,000 people.

SOURCE: *Manchester Evening News,* 1 November 2013

Czech nuclear warhead bunker opens to the public

A military bunker in Misov in the Czech Republic that housed Soviet nuclear warheads during the years of the Cold War has been turned into a nuclear museum, opening to the public in August. The Javor 51 bunker in the heart of the Misov military area was the most heavily guarded place in the former Czechoslovakia. In was built by the Czech and Soviet military and once the Soviets took it over in 1968 no Czech or Slovak was allowed to set foot in it.

In the years between 1968 and 1990 the underground compound, which had its own source of water, its own power generator and air filter, was only accessible to select members of the Soviet military stationed permanently on Czechoslovak territory following the Soviet-led Warsaw Pact invasion in 1968. The military site was off-limits to overhead flights and the Misov area was heavily guarded by Soviet troops. The bunker contained a big arsenal of Soviet nuclear warheads.

Sometime in 1964 the Soviet and Czechoslovak military signed an agreement to build a facility to house a nuclear weapons arsenal. It was the height of the Cold War and the facility was to help the Warsaw Pact to be better prepared for a possible attack or defence strike.

The massive nuclear warhead storage hall in the Misov bunker

Originally the Soviets occupied twenty such bunkers in their former satellite states outside the Soviet Union. Of these just three have been preserved – the one in Misov, one in Poland and one in Bulgaria. Unlike other bunkers stationed on Czech territory, which were put at the disposal of the Interior Ministry, the one in Misov remains in the hands of the Czech Defence Ministry which, having no good use for it, agreed to lease it to the Iron Curtain Foundation.

The Atom Museum also contains authentic objects that were left behind by the Red Army – including documentation, seals, protective clothing and special instruments that indicate the bunker really was used as a storage facility for nuclear warheads. Further proof of its former importance is the fact that the bunker is located some distance away from the central military headquarters and Soviet troops dug a long underground tunnel linking the headquarters to the bunker to enable undetected movement from one to the other at any given time.

The museum is now closed for the winter. During 2013 it was only open on Saturdays with two guided tours for 25 people. Visits had to be booked in advance but in time the Iron Curtain Foundation hopes to turn it into a much bigger public attraction.

[Members of Subterranea Britannica have visited two identical nuclear warhead bunkers in the former East Germany – one was at Stolzenhain. *Ed.*]

SOURCE: *Radio Praha,* 22 August 2013

Isle of Man radar bunker offered for sale at £50K

For just £50,000, the purchaser of this bunker in Dalby on the Isle of Man will secure an unusual piece of Manx architectural and military history that was part of a system that played a vital role in protecting the British Isles from enemy aircraft. The bunker is, in fact, the standby set house (generator building) for the Dalby Chain Home radar station.

The station was built at the start of WWII as part of an extensive radar complex spread over a wide area. Constructed of brick and reinforced concrete, the bunker is covered in soil and grass. The main hall, measuring 35ft by 24ft with a 14ft-high ceiling, boasts a dog-legged blast corridor, designed to protect the radar personnel in the event of enemy bombardment. There's also a lobby, hall and store room. To the rear is a good-sized grassed area. The downside is that access is only by right of way over a gated private lane used by the Water Authority to reach an underground sewage treatment plant next door.

The Dalby Chain Home station was built in 1939–40 as part of a network which included two other Chain Home sites on the island at Bride and Scarlett. Each site had massive transmitter and receiver masts. Dalby was designed to detect high-flying aircraft. It saw use throughout the war and for a short time afterwards.

Visitors entering the Dalby standby set house on the public viewing day

It was decommissioned in 1946–47 but was only mothballed until 1949 when it was due to have been brought back into use in the face of the new nuclear threat posed by the Soviet Union. Many WWII radar stations were reactivated but the equipment at Dalby was found to be unusable and the station was quickly abandoned.

At Dalby the radar station is now spread over two farms, Craglea and Ballahutchin Moor. Each farm has two C-type operations blocks. The receiver blocks are on Craglea Farm and both are now used as cattle sheds. The transmitter blocks are on Ballahutchin Farm. The stand-by set house, a particularly large bunker with one entrance, is at SC21697853 close to one of the two original entrances to the technical compound.

SOURCE: *Isle of Man Today,* 30 August 2013 and Sub Brit website www.subbrit.org.uk/sb-sites/sites/i/isle_of_man_radar/index.shtml

Germans campaign to stop Nazi bunker being turned into luxury flats

Standing on a hill near the centre of the German city of Aachen, the massive Lousberg Bunker served as the Wehrmacht command centre as Nazi troops fought a desperate, but futile, battle in September and October 1944 to stop Aachen becoming the first German city to fall to Allied troops in the west.

Campaigners want to preserve the battle-scarred bunker as a memorial to the thousands of Allied troops who died or were wounded in the fighting and as a reminder to all of the bloody history of the Second World War. A plaque on one of the bunker's walls reads, "On October 21, 1944 the Nazi dictatorship ended for Aachen and freedom and democracy began!"

American troops seen in front of a vast Wehrmacht command centre in Aachen in 1945

Built to house over 1,400 troops and civilians, the fortification formed a key part of the Siegfried Line, the 400-mile-long line of concrete and barbed wire German commanders hoped would bring the Allied advance to a bloody halt.

In 2012 the bunker was sold by the federal government to a firm of private developers, which announced plans to raze it and build a block of high-end apartments in its place. Campaigners hope to get the bunker granted protected building status, although this would mean the federal government compensating the developers.

Along with bombarding local councillors, 'save the bunker' campaigners have taken to the internet, launching an online petition and Facebook page.

SOURCE: *Daily Telegraph,* 4 October 2013

Underground at Bletchley Park, Buckinghamshire

A recent visit to Bletchley Park., the UK Government's Code and Cipher School during World War II (and forerunner of GCHQ), and study of the displays and guide book, revealed only one more or less underground feature: an ice-house, built to serve the pre-1938 owner's mansion.

The Victorian mansion was built in the 1870s (replacing an older building), and extended in or around 1883 by Sir Herbert Leon (1850–1926). The ice-house, polygonal on plan with a corresponding conical roof and stained-glass

windows in the above-ground part, was incorporated in a new servants' wing at the back of the mansion. Visitors will find it beside the recreated wartime post office.

What was referred to during the war as the 'tunnel' was in fact a wooden structure on the surface, linking two adjoining huts: it has been demolished.

The mansion, huts, and extensive grounds are open to the public throughout the year except 25 December, and well worth a visit. It is a very short walk from Bletchley Station, one stop on the Birmingham main line before Milton Keynes. For admission times and charges call 01908 640404 or visit www.bletchleypark.org.uk.

For details of the house and grounds and their wartime history, see Ted Enever's book *'Britain's best kept secret: Ultra's base at Bletchley Park'* (Alan Sutton Publishing Ltd, 1994).

Courtauld's air-raid shelters at Halstead, Essex

The textiles manufacturing firm Courtaulds commissioned 16 air-raid shelters for workers at its factory near Halstead, Essex, before the outbreak of World War II. The company was then engaged in war production, making for example parachute fabric. The shelters were close to the factory and at the rear of the company's employees' houses and gardens. Fifteen were sunken shelters to hold 50 persons each, formed of preformed concrete arch segments. Each of these had blast-proof entrances, electricity, chemical toilets (marked separately for men and women) and escape hatches with vertical ladders.

The sixteenth shelter was a surface-built shelter which also accommodated a first-aid centre, a communications room, and an Air Raid Precautions Warden's post. The factory suffered no damage by enemy action, although production time was lost, according to company records, as a result of 170 air-raid alerts.

The factory was closed in the 1980s and has been demolished, and the company houses sold to tenants and others. The shelters survive and have had a variety of uses such as garden sheds and the like. Although attempts to have them officially recognised as of historic importance at both local and national level have not met with success, local people with CBA support have campaigned for their conservation.

SOURCE: WOLF, Helen, 2013, Casework – Courtauld's air-raid shelters. *Council for British Archaeology Newsletter* 24.

WWII Munitions Unit under the Palace of Westminster, London

During World War II existing workshops below the Houses of Parliament were used, additionally to routine maintenance, for machining armaments components for the war effort. A documented and fully illustrated account has been published. It is noted that a similar scheme operated underneath Buckingham Palace.

SOURCE: CHRISTENSEN, Mike, 2013, The Westminster Munitions Unit. *Archive* 79, 2 – 24.

NEWS – MINES AND MINING

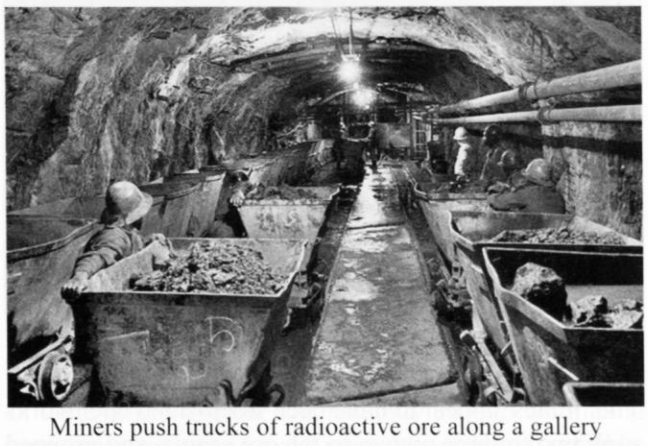
Problems at Castle Hill, Reading, Berkshire

In the summer of 2013, a small subsidence in the road surface at Castle Hill, in western Reading, resulted in traffic being diverted. Soft (or mushy) ground was reported, possibly as a result of high rainfall destabilising a 5-metre deep Victorian water main trench. However, as not so long ago chalk mining in the adjoining Coley District, at and around Field Road, caused the partial collapse and subsequent demolition of nearby houses, the presence of more unstable chalk mines might also be a possible explanation.

SOURCE: ANON, 2013, Lane in mushy road is closed till mid-month [*Local newspaper*], 3 July 2013.

A mine in the Congo fuelled the first atomic bombs

Until the discovery of nuclear fission, uranium was an ore of very limited use, and in 1939 it was also in very limited supply. There was one mine in southwestern Colorado in the region of a town called Paradox. There was another that had a small but good-quality production at Great Bear Lake in Canada's Northwest Territories, and there were the Joachimsthal mines in Bohemia.



Miners push trucks of radioactive ore along a gallery at the Shinkolobwe mine.

Uranium's primary use had been as a dye for the ceramics industry; it produced lemon-yellow, orange and green colouring at various concentrations. When Pierre and Marie Curie identified radium as a source of radiation and demonstrated its use in treating cancer, for which they were awarded the 1903 Nobel Prize in Physics, uranium mines were presented with a second market: radium is a by-product of uranium. Prices reached $3 million an ounce in 1919 and Paradox and Joachimsthal were doing well until 1922, when a newly discovered mine in the Belgian Congo came on stream.

This mine, Shinkolobwe, had been identified as a source of uranium by the English geologist Robert Sharp in 1915, who made his discovery by chance. He was working for Union Minière du Haut Katanga and looking primarily for copper. One day, while prospecting near Elisabethville, he climbed a low hill to take his bearings and noticed that the earth on the hilltop was stained with several colours. One was yellow, which he associated with uranium. Sharp

had heard that local men used coloured mud to decorate their bodies. He was told that 'Shinkolobwe' means 'the fruit that scalds'. He sent the rocks for analysis and they turned out to contain uranium at 80 percent, the purest concentration in the world. There was so much pure uranium at Shinkolobwe that the mines at Joachimsthal and Paradox in Colorado simply stopped producing it.

SOURCE: *Daily Telegraph,* 7 November 2013

Recording Wealden ironstone mines

Ironstone was mined in the Kentish, Surrey and Sussex Weald, once the 'black country' of England. The Wealden Iron Research Group has a lengthy and distinguished record of fieldwork and historical research and publication. The group's work covers, for example, mineral extraction, smelting, and casting (anything from firebacks and iron 'tombstones' to cannon), and even experimental archaeology (they have smelted and worked iron in the field). A recent paper describes the survey, using LIDAR, of numerous 'mine pits' in St Leonard's Forest.

Tramway still in place in Snape Mine near Wadhurst. Photo Barry Stewart

The 'mines' appear to have been steep-sided openworks sunk two to three metres to the ore seams, and grouped at around one to three metre intervals. There appears to be no field evidence to justify them being referred to as 'bell pits'. When one shaft was worked out, it was largely back-filled with spoil from the next one. LIDAR (airborne remote sensing, Light Detection and Ranging) can very effectively photograph clusters of these pits as the technique can 'see' through tree cover. The clusters recorded in St Leonard's Forest appear to be of sixteenth-century date, and of somewhat larger than the average dimensions for these features.

SOURCE: BLANDFORD, Vivienne, 2013, St Leonard's Forest mine pits. *Wealden Iron,* Second Series, 33.

Ironstone mining in 19th- and 20th-century Northamptonshire

Ironstone was dug opencast and mined underground in Northamptonshire for rather more than a century, from around the 1850s to 1980. Mostly the ore was worked opencast, but there was some underground mining in the ninetyeenth century at Cogenhoe. In the twentieth century ore was mined between Finedon and Wellingborough, although these mines were subsequently destroyed by opencasting to win all material left in mine pillars.

More extensive mines were worked by the Islip Iron Company between Kettering and Thrapstone from around 1902 to the 1940s, and by the Ebbe Vale Iron, Steel & Coal Company at Irthlingborough from 1924 to 1965. The last ore was raised from open pits in 1980. Two booklets published by the Northamptonshire Industrial Archaeology Group describe this vanished Midlands industry. The inter-relationship with mining development and the establishment of railways in the county is also addressed.

SOURCES: PERKINS, Peter, and Mick DIX, 2013, *Evolution of the Northamptonshire ironstone industry*. Northamptonshire Industrial Archaeology Group: 28pp [ISBN 9780-9576647-15] and CARR, David, 2012, *Irchester ironstone quarries: key dates and events*. Northamptonshire Industrial Archaeology Group: 20pp [ISBN 9780-9576647-08] [£ 7.50 + £1 p/p and £ 3 + £ 1 p/p respectively from Northamptonshire IA Group, 6 Bakers Lane, Norton, Daventry, Northants NN11 2EL]

British coal mining and the so-called 'Industrial Revolution'

Many historians have been less than comfortable with the so-called 'Industrial Revolution', not least because historically revolutions have seen the complete overthrow of the old order. The French revolution saw the end of monarchy in France; the Russian revolution likewise introduced an entirely new form of government and economic order in place of what went before.

The Industrial Revolution was marked by the massive growth in industrial output resulting from the use of steam generated by burning coal. Coal-fired steam pumping engines allowed mines to be sunk and worked at hitherto impossible depths below the water-table, for example. And, later, coal-fired locomotive steam engines led to the development worldwide of the railway system as we now know it. But while all that was going on, the older energy sources carried on for many years: watermills and windmills were not immediately eclipsed in the eighteenth century: many were still at work in the twentieth. The new technology allowed industrial concerns to be established in places other than on rivers and hilltops, but didn't lead to the immediate abolition of the older mills.

Another such 'industrial revolution' was to follow, with the development of coal-gas manufacture and other chemical technologies, and the development of electricity generation and applications, and the internal combustion engines and road transport. These allowed industrial development far from the nation's coalfields, such as the Morris car plant at Oxford, new textiles in Essex, and aircraft manufacture at Southampton. John McGuinness has expanded on this theme in a recent paper.

His second paper considers the need for a history, an overview rather than details, of the UK coal mining industry. At the start of, and indeed well into, the twentieth century the nation depended very heavily on

coal. The railways were run by coal-fired locomotives; ships and factories were kept running by burning coal; street lamps and domestic lighting were largely by gas lamps burning coal gas; homes were kept warm by coal fires; and even the new modern electricity was generated in coal-fired power stations.

But in the second half of the last century the dominating importance of coal was gradually eclipsed by the introduction of oil, natural gas, and hydro-electric and nuclear power stations. To what extent the decline and closure of, by now, almost all our British deep coal mines depended on any one cause, or a combination of causes, deserves study. Was it solely a political matter, resulting from the unions' attempt to oust the Thatcher government from power, or Margaret Thatcher's determination not to suffer the same fate as Edward Heath and to crush the unions? Or did other factors such as lack of capital investment in and after the Second World War, and the exhaustion of economically winnable reserves have major roles?

Of course, with the invention and development of information technology, we have now travelled through a further 'industrial revolution' characterised by the collation and dissemination of information (and misinformation and mischief, it has to be added!).

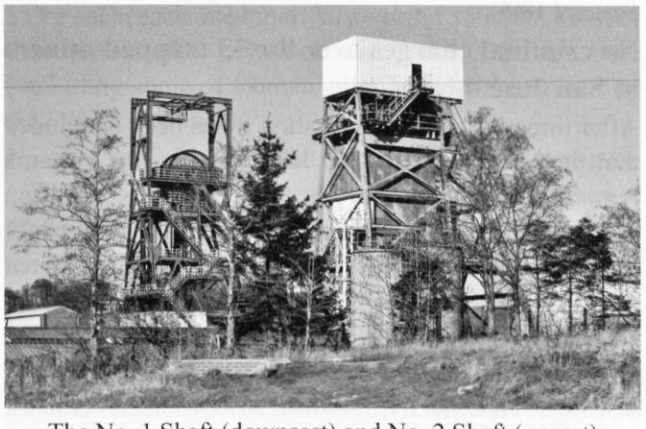
SOURCES: McGUINNESS, John, 2013, Has the term 'Industrial Revolution' still any meaning? *Industrial Archaeology News* 166; and McGUINNESS, John, 2013, The end of the British coal mining industry. *Ibid.*

Colliery spoil tip blocks rail line at Hatfield, Yorkshire

Rail traffic from Doncaster to Cleethorpes and Hull was interrupted in February 2013 by the collapse of material from a spoil tip at Hatfield Main colliery. All four tracks were seriously pushed aside and distorted by the slipped material.

SOURCE: ANON, 2013, The next 'big dipper' train will depart. *Down to Earth* 82.

Proposed nationalisation of Daw Mill colliery, near Coventry, Warwickshire



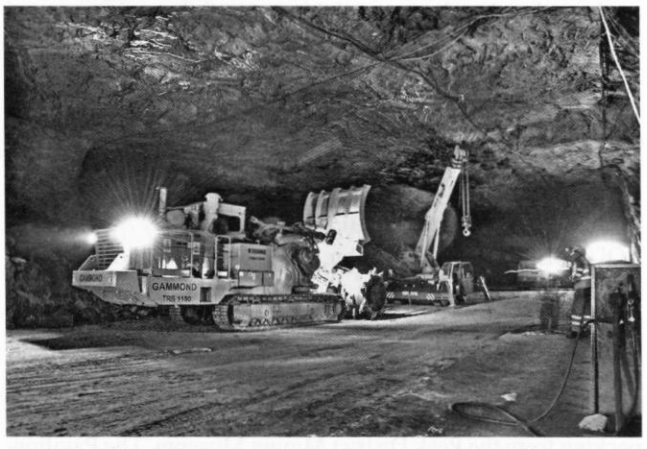
The No. 1 Shaft (downcast) and No. 2 Shaft (upcast) at Daw Mill Colliery

Daw Mill colliery, the UK's biggest deep coal mine, suffered a disastrous underground fire in February 2013, halting production and putting the life of the mine and the livelihoods of the miners at risk. In May Government sources suggested transferring the mine into state-sponsored ownership (the Coal Authority) to 'preserve the listed company behind UK Coal'. Daw Mill had reportedly cost UK Coal £100m by May 2013.

SOURCE: BOW, Michael, 2013, Ministers seek nationalisation of UK Coal mine. *City AM*, 13 May 2013

Another new use for worked-out areas of Winsford rock salt mine, Cheshire

There are three deep mines producing rock salt (mostly for de-icing roads in the winter) in the UK: Winsford (Cheshire), Boulby (near Saltburn on the east Yorkshire coast) and one near Carrickfergus in Northern Ireland. The Boulby mine produces potash (potassium chloride) as its primary product, used in agricultural fertilisers. But rock salt is also produced and sold (much of it exported) as a result of all the access roads about a kilometre down being driven in this mechanically stronger material.



In 2009 engineers work on the construction of a new £750,000 cutting machine

These mining operations result in very extensive mazes of large mined tunnels, and naturally enough the mining companies are keen to make money from them if possible. Parts of the Winsford mine (started in 1844) have for some years has been used as a storage place for the less often referred to books and documents of such places as the British Library, National Archives, police forces and hospitals.

Other (quite separate) parts of the 150 miles of the Winsford mine tunnels, nearly 500 feet underground, are now being used to store hazardous waste, material that it is now illegal to dispose of by landfill in abandoned surface quarries. Currently there are 200,000 tons in the underground store.

The waste disposal company Veolia has permission from the Environment Agency to emplace 1.6 million tons, which would occupy around 71 million cubic feet. Most of the material is in a dry powder form, and includes incinerator residues containing toxic heavy metal compounds, slag from metallurgical processes, and materials from recycled lead-acid batteries.

SOURCE: GRAY, Richard, 2013, Secret toxic waste dump hidden under a quiet corner of rural Britain. *Sunday Telegraph*, 22 September 2013

Mine surveying at Ecton copper mines, Staffordshire

One of the UK's leading mining archaeologists, John Barnatt, has published a very useful guide to the practicalities of underground surveying, with particular reference to metalliferous mines. His work in the Ecton copper mines in Staffordshire is taken as an example.

During the second half of the eighteenth century the Ecton mine, on the borders of the Peak District, was the deepest in the UK. Much of the lower parts are of course now flooded and inaccessible, but much also remains above the water table and on the surface. And it has recently been demonstrated that mining was being undertaken here as early as the Bronze Age.

Whereas some students of mining have been content to map all accessible shafts, stopes and tunnels, John Barnatt stresses the importance of archaeological examination allowing, for example, relative dating and so the developmental history of the subterranean complex. The author has sought to 'push the boundaries of how industrial sites are assessed ... by including the underground features as well as those at surface ... by giving the same weight to workings of prehistoric to post-medieval date, and ... by fully integrating historical archives with the physical record ...'

SOURCES: BARNATT, John, 2013, Underground surveying at mines: aiming towards understanding. *Mining History [Bulletin of the Peak District Mines Historical Society]* 18(5); and BARNATT, John, 2013, *Delving ever deeper: the Ecton mines through time*. Peak District National Park Authority: xiii + 307pp [ISBN 9780-901428-264] [£26 including post and packing from the Peak District Mining Museum, The Pavilion, South Parade, Matlock Bath, Derbys DE4 3NR]

Manganese mining in Warwickshire

Alan Cook has described and interpreted the surviving remains of a small and largely flooded pillar-and-stall mine for the minerals pyrolusite and psilomelane occurring in steeply inclined beds within national grid square SP 39 for which detailed historical records have not been found. Manganese dioxide was historically used to decolorise glass during its manufacture and, later, to oxidise hydrochloric acid for the manufacture of chlorine and then bleaching powder for whitening fabrics, paper, and other materials. Metal may also have been smelted from the ore for the manufacture of manganese steel.

SOURCE: COOK, Alan F., 2013, Purley Chase manganese mine, Mancetter, Warwickshire. *Mining History [Bull. Peak District Mines Society]* 18(5).

Another award for King Edward Mine, Camborne, Cornwall

Members who attended the Sub Brit Study Weekend in Cornwall in September 2010 will remember assembling at King Edward Mine, just outside Camborne. The impressively restored and maintained surface buildings and their plant and contents are open to the public: there is no public access underground. King Edward Mine has received a number of well-deserved awards over the last 25 years for the conservation work achieved by its volunteers.

It has now had a further award, the 83rd Engineering Heritage Award from the Institute of Mechanical Engineers, and the first in the southwestern counties of Cornwall and Devon. This is in recognition of the conservation and restoration in many cases to working order of machinery for tin ore concentration. Previous Engineering Heritage Awards have gone to achievements such as the Channel Tunnel, the Ffestiniog Railway, the SS *Great Britain*, and Tower Bridge.

SOURCE: THORNE, Graham, 2013, King Edward Mine: another award. *Industrial Archaeology News* 166.

Chromium ore mining in the Shetland Isles, Scotland

Unst, one of the Shetland Isles group to the north of mainland Scotland, was the location of the only economically exploited chromium ore in the British Isles. Although the twelve or so small mines were all opencast, this remote area features so seldom in *Subterranea* that it seems worthwhile recording this (for the UK) unique mining site in our pages.

The ore is chromite, an oxide of chromium, and is found in steeply inclined thin seams in metamorphosed rock. Mining is known to have taken place in the years 1823–76, 1908–27, and 1936–44. Whilst the latest period of extraction may have been in connection with a wartime demand for chromium steels, most of the output is thought to have been used in the manufacture of yellow, orange or red pigments (although of course the canary-yellow lead chromate is presumably now out of favour). Chromium is so-called from a Greek word implying colourful, with reference to its numerous brightly coloured compounds. Trevor Ford considers in detail the archaeology of the surviving remains of a horse-operated ore crusher,

SOURCE: FORD, Trevor D., 2013, a chromite ore crusher in the Shetland Isles. *Mining History [Bull. Peak District Mines Society]* 18(5).

No criminal charges over the 33 trapped miners at San José mine, Chile

After three years of investigation it has been concluded that the owners of the San José mine in the Atacama region of Chile should not face prosecution in connection with the collapse of 5 August 2010 which trapped 33 men underground for 69 days. A civil suit by the rescued miners themselves is not affected by this decision.

[see *Subterranea* 25 (Dec 2010), page 1 and *Subterranea* 31 (Dec 2012) book review, page 13. *Ed.*]

SOURCE: FRANKLIN, Jonathan, 2013, Chile: no criminal charges over 33 trapped miners. *The Guardian*, 3 August 2013.

New Zealand's Pike River mine to reopen

Contractors are making progress on the Pike River drift re-entry project. In accordance with a four-stage plan to go back inside the mine, where 29 men were killed three years

ago. In September, the Government approved the re-entry plan and committed $10 million to the effort and possible recovery of the victims' bodies. In October the New Zealand Defence Force completed the first stage of the project by removing 35 tonnes of debris from the ventilation shaft.

The damaged ventilation shaft at Pike River mine

Contractors have now begun work on plugging a ventilation shaft. The mine team had successfully placed a high-strength expanding resin into the shaft and have begun topping that with a layer of concrete. Once the concrete has set, the remaining area will be filled with an expanding foam material which will also be topped off with a final layer of concrete. The shaft sealing is needed to fully stabilise the environment in the mine, it is hoped this stage of the project will be completed by Christmas.

Planning is also underway for the next stage of the project, that is, the drilling of additional boreholes into the main tunnel.

Source: TVNZ One News 14 November 2013

NEWS – MISCELLANEOUS

Huge heaps of gold on show below the City of London

There are monstrous heaps of gold bars in vaults underneath the Bank of England. Visits are not encouraged, and Sub Brit seems unlikely to be admitted, although it would not surprise us if Linda and Martin were to manage one! However, a panoramic tour can now be viewed electronically.

There are (or were in July 2013) 400,000 bars weighing 13 kg each, each one reportedly worth £350,000. Most of them are stored on behalf of other banks, although some (including some of Roman manufacture) are owned by the UK Government.

No gold has ever been stolen from the vaults. However, a Threadneedle Street legend has it that in 1836 a sewer worker invited the Bank's governors to meet him amongst the piles of precious metal because he had identified a breach of security. They duly assembled to watch the man emerge from a hole in the vault floor! He is said to have been awarded £800 (a huge sum at the time) for his honesty!

Another tale concerns the deceased William Jenkins, a former clerk at the bank, who was buried in the garden court in 1798. This gentlemen's huge coffin (he was six feet seven and a half inches tall) was re-interred in the vaults, the most secure place in London, to foil would-be body-snatchers who would have coveted such a fine skeleton. His remains were later transferred to Nunhead Cemetery.

SOURCE: KENNEDY, Maeve, 2013, Look but don't touch. Bank lets (virtual) visitors into its vaults. *The Guardian*, 12 July 2013

Goldfinger's vault to become a City pub

The bank vault used in the James Bond film *Goldfinger* is to be turned into a bar as part of multi-million-pound plans to convert one of London's grandest buildings into a 255-room hotel.

Private members' club Soho House and New York hotel developer Sydell Group have teamed up to develop the former Midland Bank headquarters, a Grade 1-listed building on Poultry, less than a minute's walk from the Bank of England.

The vault was used to shoot the Fort Knox scenes in the 1964 film which starred Sean Connery as Bond, Honor Blackman as Pussy Galore and Gert Fröbe as villain Auric Goldfinger. The Midland Bank building, which was designed by Sir Edwin Lutyens and built between 1925 and 1937, was sold for £72 million in 2006 to a Russian business tycoon.

[The same basement was used as the set for an ITV quiz game show *The Vault* which ran for three series between 2002 and 2004. This was the first quiz show in Britain to give away £1 million live on national television. *Ed.*]

SOURCE: BAR-HILLEL, Mira. Bond bank vault to be turned into gold bar, *Evening Standard*, 11 November 2013

Population expansion forces Singapore underground

Singapore, with a little less land mass than New York City, is running out of room for its 5.4 million people. But as one of the world's most crowded cities, and with projections for 1.5 million more people in the next fifteen years, Singapore's options are as limited as its space.

So Singapore is considering a novel solution: burrowing underground to create an extensive, interconnected city, with shopping malls, transportation hubs, public spaces, pedestrian links and even cycling lanes.

Height restrictions imposed on areas around air bases and airports have prevented developers from building taller projects. And there is a limit to how much land can be reclaimed from the ocean – so far it accounts for a fifth of Singapore's space but is vulnerable to rising sea levels caused by climate change.

The squeeze has led to the closing of several old estates and military camps to make way for residential and industrial developments. Building underground is not new in Singapore. About eight miles of expressways and about fifty miles of transit lines are below ground. Drainage systems and utility tunnels are common features beneath the urban landscape. Now Singapore is going further, beginning work on a huge underground oil bunker called Jurong Rock Caverns. When this is completed, it will free about 150 acres of land.

Another project on the drawing board is the Underground Science City, with forty interconnected caverns for data

centres and research and development labs that would support the biomedical and life sciences industries. The science centre, with an estimated fifty acres to be thirty storeys below a science park in western Singapore, would house as many as 4,200 scientists and researchers.

Three underground levels of the ION Orchard shopping mall in Singapore

Subterranean projects can be three to four times as costly as surface projects because of higher construction costs and the need for extensive soil investigations. But the idea of working and living underground has met with some scepticism from the public. Over the years many people have relocated from traditional Malay villages to high-rise living in government flats and now they have finally adjusted to living in these residential buildings, there are plans to move them below ground.

At the city's two oldest universities, Nanyang and the National University of Singapore, studies have identified suitable areas to build sports facilities, libraries and lecture theatres below ground. According to researchers from both institutions, students may one day swim in an underground pool or watch a film in subterranean cinemas.

But even with the current projects, subterranean development in Singapore is still in its early stages. It is a massive investment that will require comprehensive studies and careful planning.

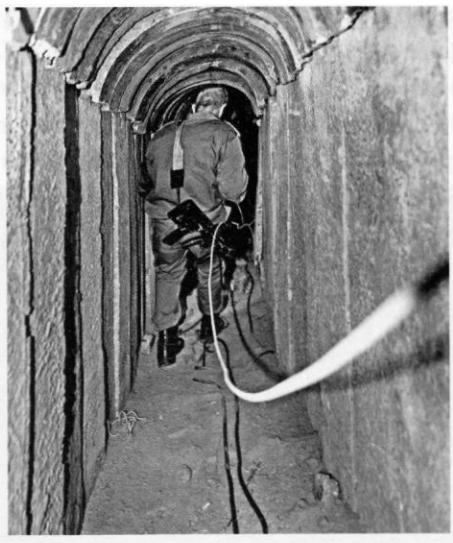
SOURCE: *New York Times,* 25 September 2013

1.05 mile long sabotage tunnel found in Gaza

The Israeli military have discovered an underground tunnel dug out from the Hamas-controlled Gaza Strip into Israel. It said it believed militants had intended to use the tunnel to attack or kidnap Israelis.

In response, the military froze the transfer of all construction materials to the Palestinian territory. But a Hamas military spokesman in Gaza was defiant over the tunnel discovery, saying that "thousands" more tunnels would be dug. Hamas has dug tunnels into Israel in the past. In 2006, Hamas-allied militants sneaked into Israel through one such tunnel, kidnapped a soldier, and held him hostage in Gaza for five years.

According to the Israeli military, the latest tunnel is 1.05 miles long and appears to have been recently dug and in use until its discovery last week. A tunnel opening



was found near a kibbutz along the Israel–Gaza border, and the military speculated that Hamas may have been planning an attack on a kindergarten there. The military said it waited a week to publicise the discovery because a search for explosives was under way. An elite engineering corps was sent into the tunnel, but would not say whether explosives were found.

Prime Minister Benjamin Netanyahu praised the discovery of the "Gaza terror tunnel" and said Israel's resolute policy towards the Gaza Strip, including last year's military offensive, has led to the "quietest year in more than a decade" along the Israel–Gaza border. For years, Israel prevented the transfer of construction materials into Gaza because it said militants could use the materials to build crude rockets and explosives for attacks against Israel. But in recent years, Israel began allowing some of those materials and in 2010, started allowing the delivery of building materials for internationally funded projects. In September, Israel also started allowing construction materials into the Palestinian territory for the private sector.

SOURCE: *Daily Telegraph,* 13 October 2013

Rumours of subterranean passages from Canonbury Tower in north London

One subject guaranteed to draw snorts of derision from local historians of old was the suggestion of secret underground passages leading out from under Canonbury Tower. What is not in dispute is that Canonbury, once plentiful in springs, did supply water to the Priory of St Bartholomew in West Smithfield. To confuse passage hunters, "the water pipes used in those times", reported Nelson in his 1811 History of Islington, "were not always embedded in the earth as is the present custom, but enclosed within a capacious arch of brickwork".

Our Man from the *Star*, a London evening newspaper which ran from 1788 to 1960, was not to be put off. Writing on 6 September 1907 (under the headline "Mediaeval Monks Whose Secret Passage Is Now A Wine Cellar"), he agrees that subterranean passages leading to the priory in Smithfield or to Limehouse were there "to supply the

monks with water". But then he goes on: "At the Marquess of Northampton's estate office, the '*Star*' man learned that only one real secret passage is known to them. This is over 5ft high, and was evidently used for pedestrians, and not for water. Starting in the vaults under Canonbury, it runs down under the long gardens at the back of the houses in Alwyne-villas, and reaches the New River under a house in Alwyne-road, but is there blocked up."

Canonbury Tower

Our Man, now clearly having worked up a journalistic thirst, then repairs to the *New Crown Hotel* (in St Paul's Rd, now the closed *Bastille Brasserie*) to talk to mine host, Walter Longhurst. Apparently, a workman laying cables had "driven his pick through the soil about 4ft 6in below the surface of St Paul's Rd, and had a narrow escape of falling into the gulf that yawned before him." One of the men was let down into the mysterious chasm. He found himself in a pitch-dark enclosure with no sign of life. 'Ere, haul me out of this!' said the startled explorer, and he was got out. "It was then discovered that the tunnel into which they had broken led into the wine vaults of the *New Crown Hotel*, 60ft away. Mr Longhurst says in his opinion, it extends to Canonbury Tower in the same way that the one in Alwyne-villas runs out from the Tower southward."

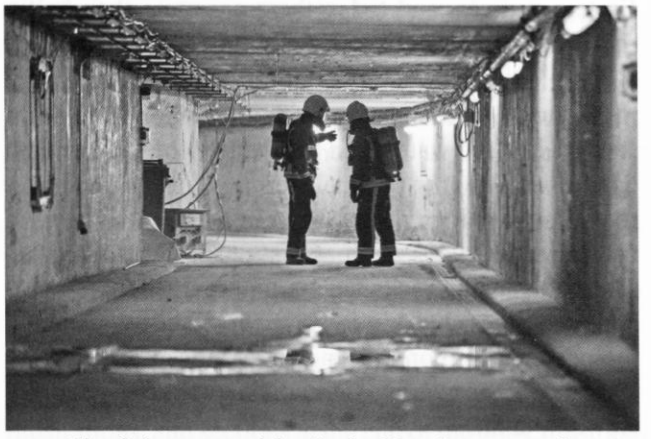
He rejects the idea of a water conduit or drain – the 6ft height of the tunnel disproves that. "There is no tradition of a tunnel at this exact spot. Obviously, if the tunnel was used by the monks as a secret means of exit or entrance, it would be natural to place its mouth in a sequestered rural spot..."

SOURCE: *The Canonbury Society Newsletter,* Spring 2013

A new use for Birmingham's Mail Rail

A network of tunnels beneath Birmingham New Street station, closed for nine years, has been reopened for fire fighters to use for exercises. The 433ft-long tunnels, which are 13ft below the station platforms, closed in 2004. They were previously used by Royal Mail post trains to transport mail from the station to regional sorting offices.

West Midlands Fire Service has been using them in exercises to test new breathing apparatus. Crew Commander Mark Clifton said: "Around 40 fire fighters from seven of our stations were involved in the two-hour exercise, which was based on a rescue scenario. The tunnels were a perfect place to test new breathing apparatus."



Fire fighters exercising in the New Street tunnels

Network Rail said when the £600m redevelopment of Birmingham New Street was complete the tunnels would be used for staff accommodation and also a catering centre.

SOURCE: *BBC News - Birmingham & Black Country,* 11 September 2013

Another basement subsurface extension goes wrong in Belgravia, London

Things didn't go entirely to plan recently with a basement extension at a property in Chester Row, Belgravia, both for the owners and the neighbours. As a result of undermining, a skip positioned outside on the pavement subsided into a void, and residential properties suffered from subsidence, cracks appearing in various places. There is now a long-running legal dispute concerning payment for repairs, from which the lawyers will doubtless benefit.

SOURCE: BAR-HILLEL, Mira, 'We still need £250,000 repairs three years after basement dig disaster. *The Evening Standard*, 29 October 2013.

Covered reservoir unroofed for repairs at Hampstead, London

The Kidderpore reservoir at Hampstead was built in 1867, and supplies 11,000 homes with water. An aluminium roof erected in 1963 is now being replaced by a reinforced concrete structure. In September the reservoir was drained, and sunshine allowed in to illuminate the handsome brick supporting pillars and arches. Thames Water plans to have the work completed and the reservoir back in service by 2015. It is stated that, by law, public supply reservoirs have to be covered as a result of a cholera epidemic in 1846 (although the cover to an 1880s reservoir at Addington Hills, Croydon, did not prevent a typhoid epidemic in that town in 1937).

SOURCE: BLUNDEN, Mark, 2013, Victorian arches exposed after decades under water. *The Evening Standard*, 13 September 2013

Hydraulic fracturing (fracking) for shale gas

George Phydias Mitchell [1919–2013], the 'father of hydraulic fracturing' (fracking) for shale gas has died aged 94. The technique piloted by him in the USA

has transformed that nation's economic status from a 'gas-guzzling' importer of hydrocarbon fuels to energy independency. The USA no longer depends on Middle Eastern sources, and today there are more than half a million shale gas wells in the country.

The technique, in which water at very high pressure mixed with sand and unspecified 'chemicals' to form (the pressurised water) and keep open (the sand grains) extensive networks of small fissures in the shale host rock, so allowing the gas to be released, has been in use since the 1940s, with at first unspectacular results. The shale source rocks have a high porosity, the pores containing gas, but a very low permeability, meaning the gas-bearing pores do not interconnect to a useful extent, so gas can move through the rock only painfully slowly if at all.

George Mitchell's solution to exploiting the resources depended on advances in borehole engineering. Clusters of deep vertical boreholes are sunk to great depths into the shale and, at the required depth; individual bores can be turned through 90 degrees to tap shale in all directions over a considerable area. Success came from the 1990s onwards.

There have been well-publicised problems in the USA which are thought, by some at least, to be less relevant in the UK, largely because of the stricter environmental controls obtaining our side of the Atlantic (although it has to be said that the current UK Government seems minded to lift various restrictions under the guise of 'improved efficiency' and (doubtless) reducing expenditure).

Engineering and economics aside, it is argued that to tap and exploit ever-increasing quantities of fossil fuels now is short-sighted on a global and longer-term view. The shale gas, like coal and oil, is a finite resource, which the human race will want to use for centuries to come. Shouldn't we leave plenty for our grandchildren's grandchildren in the ground? It is by no means certain that the promised limitless and clean nuclear fusion energy theoretically producible will be technologically feasible and affordable. And enthusiasm for nuclear fission sources has dwindled in recent years on account of well-publicised disasters, and the problem of how to store safely the radioactive nuclear waste.

In the 1950s the British Government sponsored advertisements claiming the energy from a single Edmundson railway ticket would be enough to drive a train all round the world (25,000 miles or so). And electricity would be so cheap there would be no need for meters! As if!

SOURCE: MITCHELL, George Phydias (1919–2013), Obituary. *The Guardian,* 5 August 2013. [Born 21 May 1919 / died 26 July 2013]

A new folly in Shropshire

The construction, not yet completed, of an entirely new folly at an unidentified location in Shropshire has been described. It consists of an underground room below a tortoise-shaped dome, and a communicating tunnel.

SOURCE: TERRILL, Alan., 2013, The tortoise tunnel, Shropshire. *Follies* 22(3)(86).

Another interpretation of Williamson's tunnels at Edge Hill, Liverpool

A visit report published by the Royal Archaeological Institute includes some information and comment on the curious tunnellings at Edge Hill instigated by Joseph Williamson (1769–1840) which have been interpreted as either the follies created for fun by a rich and eccentric man, or as a work-creation scheme for the unemployed. The report states that in or about 1806 Williamson purchased a house and land from an Edward Mason at Edge Hill.

Williamson's double tunnel before restoration.
Photo Nick Catford

Williamson's house, of which the façade (only) and sub-surface voids survive, stood in Mason Street, presumably named after the previous landowner. In 1812–13 Edward Mason caused to be built St Mary's Church, still standing nearby. Williamson himself built additional houses on Mason Street. The author of the report, a collateral descendant of Mason, suggests that Williamson's tunnels are in fact opencast quarries for stone for the local building projects at Edge Hill, subsequently roofed over and used, in the first instance, as cellars for the houses built above them and, in time, convenient voids in which to dispose of later demolition debris and domestic rubbish.

Members who have, with the Friends of Williamson's Tunnels, visited that energetic group's sites below Williamson's House and nearby at Paddington will remember seeing large squared stones (and a lot of brickwork) in built fabric below ground at both places. They may also have inspected *in situ* rock at the Mason Street end of the cavities under Williamson's house, and noted that whereas some of the sandstone looked eminently sound and suitable for building-stone, some looked quite the reverse, being thin-bedded and crumbly.

For any excavated sub-surface cavity, of course, a first question is the destination of the removed material.

If some of the stone excavated for Williamson went into local buildings, as seems likely, some would also certainly have been disposed of as useless waste, which in principle would still be detectable. Whether building-stone was the primary purpose of the tunnels, or no more than a convenient way of getting rid of the result of digging tunnels for fun or to employ the unemployed, remains undetermined.

SOURCE: WILLIAMS, Howard (edr), 2013, Liverpool and south Lancashire. Report and Proceedings of the 158th Summer Meeting of the Royal Archaeological Institute in 2012. *Archaeological Journal* 169 *Supplement*: 59pp [ISBN 9780-903986-624]

Narrow escape in a drain shaft at Swansea, South Wales

Many children, no doubt, play the 'don't tread on the cracks between the paving stones' game when walking along the street. So far as your scribe can remember these distant days of his childhood, the risk was that 'the bears will get you'!

Recent reports in *Subterranea* have referred to the greater dangers posed by exploding manholes, generally it seems a result of malfunctioning high-voltage cables. Now it has been reported that one Thomas Halfpenny has accidentally discovered another manhole hazard. At the age of four, young Thomas is hardly a heavyweight. Nevertheless, a manhole cover collapsed underneath him in Swansea, resulting in his rapid descent to nearly two metres below ground level. His view of the open land behind his school suddenly changed to a close inspection of the side walls of the deep narrow shaft.

Fortunately the falling cover seems to have become wedged on step-irons in the shaft, preventing him from reaching the bottom at some unstated depth. So, clearly, one would be well advised to make a risk assessment, say, every minute or two through the day, wherever you are.

SOURCE: ANON, 2012, Tom has that sinking feeling … *Metro,* 8 March 2012

NEWS - PUBLICATIONS & BOOKS

United Stone Firms Ltd: underground quarries depicted

Details: *United Stone Firms Ltd.* Forest of Dean Stone Firms Ltd, 2012: 146pp [ISBN 9780-9574590-07] Reprint of a work published in 1912. [£50 + £4.95 p/p from Forest of Dean Stone Firms Ltd, Bixslade Stone Works, Cannop Road, Parkend, Glos. GL15 4JS]

Review by Paul Sowan

In 1912 the United Stones Firms Ltd published a sumptuously illustrated book featuring the quarries and works of their several associated companies, along with colour photographs depicting each stone, and details and photographs of buildings in which each stone had been used.

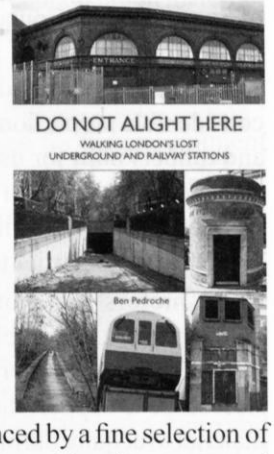
This large format hardback book has now been superbly reprinted. At least four of the featured quarry operators worked stone wholly or partly underground, and for three of them photographs of the underground workings are included in the book. These are the quarries for Nailsworth stone at Balls Green, Nailsworth, Gloucestershire; Bath stone, Somerset / Wiltshire; and Shamrock stone, Caherbarnagh, County Clare. Forest of Dean stone itself was also, to a small extent, quarried underground, although the photographs published for this material show only the openworks. The Irish site depicted shows 'tunnelling for flagstones' with men at work under a supported mass of overlying rock.

Altogether some thirty or more operators are featured and illustrated, ranging from Cornish and Welsh granite and 'granite' quarries to building limestones and sandstones. There is descriptive text accompanying the illustrations, and sections at the end of the book illustrate the associated shipping operations and the London works and depots at Addison Wharf, Kensington (GWR), Crown Wharf (Chelsea), Chelsea Wharf, and Stewarts Lane (Wandsworth). Tipped in at the front of the volume is a brief overview of the history of the several companies represented by the United Stone Firms, and of the subsequent history of the Forest of Dean company.

Do Not Alight Here

Details: *Do Not Alight Here – Walking London's Lost Underground and Railway Stations.*
Ben Pedroche. 2011. Pub: Capital History, 144pp. 78 colour photos, Softback 11 x 18cm. £6.95
[ISBN 978-185414-3525]

Review by Stewart Wild



This pocket-sized compendium, obviously written by an enthusiast, would make a good addition to any London Sub Britter's backpack. Twelve suggested walking routes in, around and across the capital, with thoughtful narrative on abandoned surface and underground buildings and their relevance to the public transport infrastructure, are enhanced by a fine selection of photographs. These are complemented by nine suggested train rides, above and below ground and all under an hour, to allow the reader to explore London's rail transport history from another angle.

In this first edition there are a few mistakes and misprints which can be forgiven, but what is a definite weakness is the complete lack of maps of any sort – I hope this can be remedied in a future edition. The book concludes with 'More things to see', useful links to book titles and websites (including Sub Brit's) and a comprehensive index. Priced at under seven pounds, this would make an ideal present for anyone curious to know more about our capital's fascinating railway history.

Surrey County Council's Deep Air-raid Shelters, Part 2

The operational life 1942–45, closure in 1946, and postwar uses of the four completed deep air-raid shelters in east Surrey

Paul W. Sowan

The story so far

This paper continues one published in *Subterranea* 33 (September 2013), and considers the history of the Ashley Road (Epsom), Longdown Lane (Epsom), Brighton Road (Coulsdon) and Godstone Road (Kenley) shelters following their completion in 1942. The exact locations of the shelters are given in the earlier paper. The main sources of information used are the records of the Surrey County Council's Special War Executive Committee (SWEC) 1939–46, and of the Coulsdon & Purley Urban District Council's War Emergency Committee (WEC) 1939–46, and local newspaper reports.

General Information from the County Council Records

The Chairman of Surrey County Council reported in 1942 that he had invited the dignitaries of the Coulsdon & Purley and Epsom & Ewell Councils to visit the Ashley Road shelter on 6 June 1942, and that at Godstone Road later in the same month. But it was as late as 16 November 1942 before all four shelters were stated to be complete.

Water ingress, condensation and rotting bunks

By 9 August 1942 it was already obvious that the dampness of the shelters was a problem. The Chairman of Surrey County Council reported that he had authorised the removal of sheets and pillow cases to 'some drier place of storage'. And damp in the shelters was making a considerable proportion of the bunks themselves (hessian and timber) unfit for use. Conditions underground were also stated to be 'ideal for the growth of moulds'. The wooden bunks were 'likely to collapse' as the moulds evidently were partial to timber as well as to hessian.

Hygrometers were ordered but many bunks were condemned as unusable the following month. It was suggested that the fabric bunks should be replaced by steel strips to support the sleeping occupants: not an easy material to acquire during the war, and indeed it was found to be 'not available'. In March 1943 a request for metal bunks to replace the rotting timber ones was refused.

In September 1942 the Godstone Road shelter was said to be the 'most attractive' of the four shelters, although perhaps 'least repulsive' might have been a better choice of words. 'It appears essential to do something drastic about the hessian bunks … there is not the strength or resistance of a small sheet of newspaper … [they are] … quite useless'. The County Engineer was instructed to consult the Institution of Civil Engineers for advice on keeping the shelters dry.

In February 1943 the Ashley Road (Epsom) shelter was declared to be 'uninhabitable throughout', with pools of water on the floor. Some wardens reportedly went about their duties in gumboots. At Longdown Lane (Epsom) the shelter was, 'if anything, wetter', and many of the electric lamps were out of action: water was observed in some of the glass covers. Brighton Road was 'quite unsuitable for sleeping in' and had 'no water-borne sanitation'. Godstone Road, however, in March 1943 was 'Quite dry and habitable throughout … used by quite a number of local people all night as a result of recent alerts … the condition of this shelter is excellent.'

View from the bottom of an unlined ventilation shaft in Ashley Road. The need for the brick vaulted tunnel lining is clear from the fractured state of the chalk through which the tunnel was made. The iron pipe remaining in situ may have been the water supply pipe from an external main. Photo Nick Catford

In connection with the problems of water affecting the electric lighting, in May 1944 the County Engineer was instructed to consider the advisability of boring holes at intervals through the metal conduits carrying the cable, to let the water out!

Causes and remedies

There followed lengthy discussions as to the origin of the unwanted water. Two theories were advanced; together they probably adequately represented the truth. Rainwater was penetrating the chalk above the tunnels, and finding its way into them through the unlined or brick-lined ceilings: there having been excessive rainfall in January 1943. And water was condensing from humid air onto cold surfaces. Godstone Road offered a drier and more acceptable environment as a result of the much greater depth of overlying chalk at that site, although some ingress was noted even here.

Two remedies were suggested: the installation of heaters, and the provision of additional forced ventilation.

The inner end of the northern of the two sloping ventilation shafts which communicate with high level openings in the face of the small chalk pit from the floor of which the shelter tunnels were excavated. The main ventilation shaft (a vertical steel pipe of about 18 inches diameter) and the ventilating fan were at the inner end of the shelter.

Photo Nick Catford

In April 1943, Sir Alan Gibb & Partners were commissioned to advise on the installation of air conditioning at the three worst shelters, and following inspection by one Mr Early, reported on 22 April. The total capital cost was estimated to be £11,580. An updated report, this time relating to all four shelters, resulted in the estimated cost rising to £17,143 which also included additional wire fencing at Ashley Road and Godstone Road to protect against falling chalk at the entrances. The additional expenditure was refused by the Government authorities, although the firm's consultancy fee had of course to be paid.

The report is of interest in that it contains a plan of the Longdown Lane shelter 'as built' and indicating the proposed positioning of ventilation ducting. This indicates vertical shafts, apparently emergency escape shafts, to either side of the main entrance. Such an arrangement seems also to have been used at Ashley Road, as both the Epsom shelters would otherwise have had only a single entrance and exit from a sloping cutting. Emergency exits at Brighton Road and Godstone Road, on the other hand, were adits at ground level.

Funds not being forthcoming for forced ventilation or for heaters, instead the bunks were treated with fungicide, and fabrics were taken outside the shelters on good 'drying days'. Some funding was found however for auxiliary petrol-engines for the ventilation fans.

Other issues

Access, supervision and security at the shelters posed problems. Should they be continuously manned at all times (with possible cost implications if paid wardens were employed), or opened only in the event of an air-raid warning? These questions exercised the County Council authorities as well as those at local level. On 10 February 1942 it was minuted that ..

> If shelters are left open they are used for misconduct and as conveniences ... wilful damage is constantly occurring and thefts of electric light bulbs, lamps, tools, fuel, and even bunks ...

These problems are stated to have been common at all public shelters, tunnelled or not.

View of the main entrance at Ashley Road in 1996; an earlier door lies on the ground nearby. Photo Nick Catford

At Ashley Road, there were problems with the steep-sided access cutting. The 'disintegrating effect of winter weather' on the chalk face had resulted in rock falls, and it became necessary to reprofile the sides to a shallower angle, and to install wire fences to contain fallen material. Additional costs were thereby incurred. Falling chalk also called for protective work on exposed chalk faces at Brighton Road and Godstone Road.

In March 1942 approval was given for the appointment of two shelter wardens, at Ashley Road and Godstone Road, at £3-14-0d (£3.70) per week from 9 March and 18 March respectively.

In June 1942 authorisation was given for the purchase of four Elsan sanitary trucks (known colloquially as 'honey-wagons') for use with Elsan closets. Whilst Brighton Road and Godstone Road had gravitationally operating mains drainage, the Ashley Road shelter had a sump and ejector pump, and the Elsans were probably required at Longdown Lane too. The mains drainage at Coulsdon and Kenley probably explains why those two shelters found commercial use after the war.

On 28 August of the same year the SWEC agreed that the enigmatic end chamber at Godstone Road should be reserved for use as an 'isolation chamber' although whether this related to infectious diseases or to disruptive shelterers is not clear! County Council minds were refocused on the question of air raids when on Thursday 6 July 1944 a V1 flying bomb completely destroyed the Ashcombe Room block at County Hall at Kingston, fortunately at 06.40 am when presumably staff were not present.

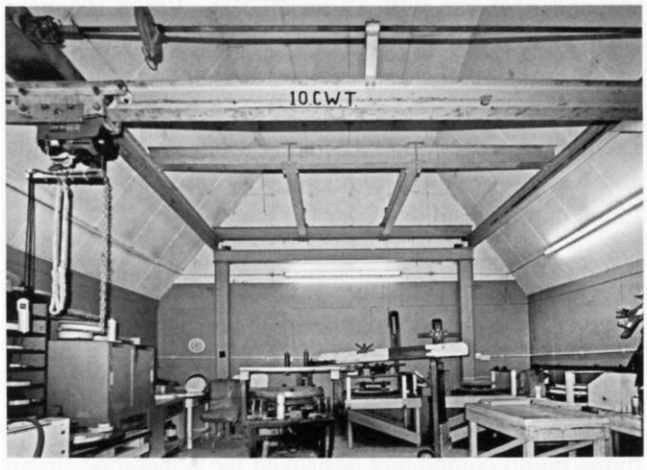
Specific Local Information for Coulsdon and Purley

Complaints about access to Godstone Road shelter in 1943

Access to the Kenley shelter was discussed by the WEC on 26 January 1943, by which time it had been open for some months. 'The Committee gave consideration to making representations to the County Council in connection with the opening of the deep shelter at Kenley'. The Clerk submitted letters received from Kenley residents Mrs F.M. Collier and Mrs M.A. Wilson, and also reported complaints received by telephone.

> It would appear that a number of local residents (chiefly women with children living in the Little Roke area and whose husbands are serving in HM Forces) desire the shelter to be opened every evening at dusk, thus avoiding the dangers which are attendant upon walking through the streets to the shelter after the alert has sounded, sometimes in very inclement weather. Those wishing to use the shelter have expressed their willingness to keep it clean. The Clerk reported that he had spoken over the telephone to an official of the Surrey County Council who had informed him that the question of opening the deep shelters had been considered by the County War Emergency Committee on 25 January 1943, and that the Committee had decided to continue their present policy of opening the shelter on an alert. Having given this matter their careful consideration the [Coulsdon & Purley] Committee instructed the Clerk to suggest to the County Council that they should make the necessary arrangements for the shelter to be opened every evening at dusk and that the local authority should be authorised to issue up to 200 permits to local residents enabling them to gain access to the shelter, in the same way as is done in many parts of London, and to point out to the County Council that in the opinion of the Committee there would be little difficulty in obtaining locally persons to act as shelter wardens on a rota basis if this request was granted.

The Little Roke area lies just over half a kilometre from the shelter up the Godstone Road towards Purley.



At the north end of the middle tunnel at Kenley there is a chamber that is 20ft in height. In recent years it has proved a useful loading area for Optical Surfaces with an overhead gantry being installed there. Photo Nick Catford

> With regard to local public air-raid shelters the Officers reported that there had been no general demand for these to be opened outside alert periods. The whole of the shelters had been inspected and with one exception, where there was a little dampness, the whole of the shelters are fit for use by the public. The Committee instructed the Officers to exhibit at each shelter a notice explaining how immediate access to the shelters can be gained during an emergency, and giving particulars of the nearest Warden's Post at which the key to the shelter can be obtained outside alert periods.

Subsequently there was a report from the Medical Officer of Health concerning a letter received from the County Medical Officer of Health suggesting that 'certain medical equipment at present stored in the deep shelters' should be withdrawn and stored by the local authority 'under more suitable conditions'.

Surrey County Council responded on 16 March 1943 …

> The [County Council] Committee directed that the shelter should be opened every evening at dusk and that arrangements should be made whereby local residents living in the vicinity of the shelter should form amongst themselves a rota of duty. It was decided that there was no necessity to issue tickets, and that on an 'alert' canteen facilities should be available, if possible. There shall be no other use of the canteen. A report of the Shelter Warden on the air raids during the period Sunday 17 January to Tuesday 19 January, 1943, was received and noted.

The warden's report has not as yet been traced.

Representations concerning opening hours at Brighton Road shelter in 1943

Most relevant entries in the Urban District Council's WEC Minutes concern the Kenley shelter, there being little mention of that at Brighton Road. This probably reflects the fact that, unlike Kenley, the land immediately adjoining the Brighton Road shelter was largely open land. Most users, perhaps, travelled from some distance by bus or train, whereas at Kenley a great many more lived within walking distance.

However, on 14 March 1943, the Chairman …

> … reported the receipt of a letter from Councillor Benbow enclosing a copy of a communication which has been forwarded by residents in the Hooley area to the Surrey County Council in which a request is made for the deep shelter at Coulsdon to be opened day and night. The petitioners have received a communication from Surrey County Council in reply stating that the present instructions are that the shelter should be opened immediately on an alert and remain open during the period of the alert. At present it is not intended that the shelter should be used as a dormitory shelter. The Clerk reminded the Committee that the deep shelter at Kenley is opened as dusk and remains open until the following morning. The Committee instructed the Clerk to communicate with the County Council suggesting that a common policy should be followed by the County

Council in respect of the two deep shelters in the Urban District.

The Brighton Road shelter was not finished as planned with only three of the intended six cross passages being excavated. A coating machine from Cox Hargreaves and Thomson was stored in the bay and is still there today. See page 37 for a closer view. Photo Nick Catford

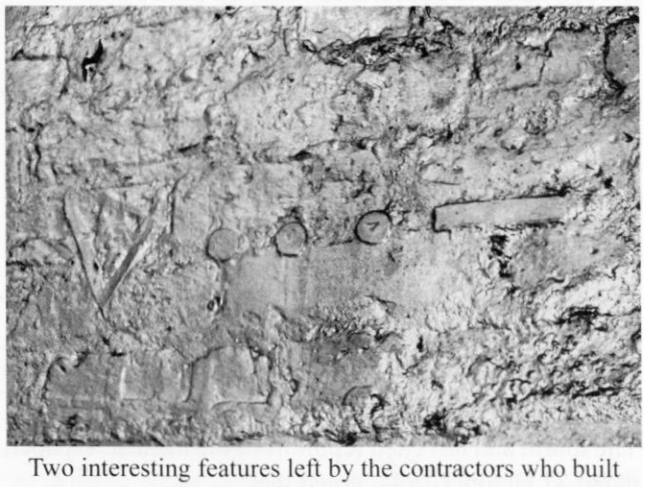
Accounts of Harold Lawrence, shelter marshal at Godstone Road in 1943–44

The 5 February 1943 issue of the local newspaper contained the following information provided by the shelter marshal, Harold Lawrence, in response to some unspecified criticism at a recent meeting of the Urban District Council …

> Since the completion of the deep shelter at Kenley there have been 30 alerts and the shelter has been immediately opened and ready to receive any who have sought safety there. It has never been locked at any time after the alert was sounded … At the time of the raid of January 17–18, I opened it as soon as the alert sounded and a number of people at once availed themselves of the opportunity to shelter there. When the 'all clear' went and everyone went home I closed it, but reopened it in the early morning when the second alert went and I kept it open until daylight. It was open again on the next night when the alert went, and more than 100 people came there. On the following night, when the weather was bad and a raid seemed less likely, only 18 people came. The WVS [Women's Voluntary Service] opened the canteen, and a representative of Surrey County Council came to see what arrangements were being made. On Wednesday, January 27, during the daylight raid, a number of people who were in the streets, such as women shopping, came in and it was opened for the alert again that evening,

Lawrence went on to assure the reporter that although the shelter was 'at present available for anyone to use wherever they lived' a 'certain number of bunks had to be reserved for people from London or elsewhere who were 'bombed out'.' Such people from further away could have arrived by bus or train via Croydon and Purley. In a further interview, reported on 30 June 1944, Lawrence provided further information on the shelter now rather vaguely reported as 'somewhere in southern England' and with a reported capacity of 2,000 persons. Down under the cliffs, the reporter continued, Harold Lawrence's word is law, but 'not Gestapo law. The shelterers know and appreciate his care for their comfort and safety.' Long passages lined with numbered bunks were noted, these being allocated by Lawrence, so presumably he kept some kind of plan of the place and register of occupants, and indeed probably a log book too. There was a 'medical section' which will 'shortly be administered by a trained nurse. Until the nurse takes over, Mr Lawrence will continue to give first aid. Doctors pay frequent visits'.

> Our shelter is a true democracy … every possible type and class of person assembles here and they all mix freely. They begin to stream in at black-out time. Lights out is at 10.30 pm. In the long winter evenings entertainments are organised. In summer shelterers prefer to go straight to sleep. It's a fine study in psychology and there are sometimes clashes of temperament, I can tell you, but although over 100,000 people have passed through my control, I have had to evict only four.



Two interesting features left by the contractors who built the Kenley shelter. In the top picture the frog has been impressed with the word 'VICTORY' where the maker's name is usually found. This brick has been deliberately reversed in the wall. This is in one of the cross passages. In the southern main passage an embossed V (for victory) has been embossed as a Roman letter and in Morse code. Photo Nick Catford

Shelter life

No 'shelter rules' have been discovered for the Surrey shelters. The following however, are displayed (painted on the wall) in the Chislehurst Caves, and may have resembled those at Coulsdon and Kenley. However, it should be remembered that in the early part of the war the Chislehurst shelter was a private initiative of James Geary Gardner of Kent Mushrooms Ltd, only passing into local authority control a year or two later. It also accommodated much larger numbers of people than all the Surrey shelters combined, reportedly about 15,000 as against Surrey's planned 7,500 and (in practice) 5,000 or so.

Caves rules at Chislehurst

[1] No admission or re-entry to the Dormitory Section after 9.30 pm. (10 pm in Double Summer Time).
[2] Shelterers already asleep in the Main Caves must not be disturbed by people coming to their pitches.
[3] Pitches must be kept clean.
[4] No furniture admitted.
[5] Stoves of all kind prohibited.
[6] Rubbish must be placed in the bins.
[7] Children should be in their pitches by 9 pm and stay there,
[8] Unauthorised sale of goods is prohibited.
[9] There must be reasonable quiet by 10 pm
[10] Lights out and absolute silence by 10.30 pm in the Dormitory Section.
[11] Pitches must not be changed, exchanged or sold.
[12] Four days absence may involve loss of pitch.
[13] The Cave Captain controls his section.
[14] Music must cease by 9 pm.
[15] Organised concerts can only be held by permission.
[16] Breach of rules involves loss of pitch.
[17] Arrive early and stay put.

By order

Caves Committee

These rules imply a number or organisational features, including the presence of 'cave captains' for each section, and the keeping of some sort of register indicating those allotted to specific numbered bunks or 'pitches'.

An underground party at Godstone Road – October 1944

The fourth and last cited report from the local newspaper, dated 27 October 1944, noted that …

> Approximately 1,000 people, coming from all parts of south London and Surrey, are still sleeping in the Kenley deep shelter – cut under the cliffs in Godstone Road – every night. Many of them who have been made homeless by flying bombs are living there during the day as well. But they are not at all down-hearted, and on Saturday – as this picture shows – they held a party in thanksgiving for their safety during the raids.

The underground party at Godstone Road in 1944.
Photo from PB Prosper

This report is accompanied by a photograph of a party held underground on Saturday (21 October 1944) which shows children sitting down to a tea-party in one of the tunnels with all the luxuries rationing would allow, adults standing behind them, and Union Jacks prominently displayed.

Closure in 1945–46

Closure of the east Surrey shelters

The war in Europe ended on 7 May 1945, with the unconditional surrender of Germany. On 15 May the WEC at Coulsdon & Purley considered London region *Circular* 931 which directed that …

> All public and communal shelters (other than those needed for the homeless) should be closed and such measures as are possible taken to prevent access by unauthorised persons.

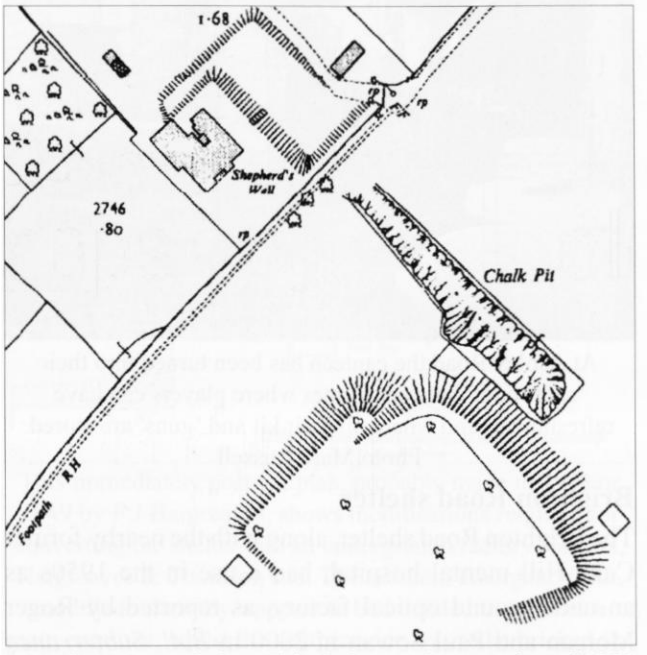
It was resolved to remove all salvageable fixtures and fittings from the shelters, block them all up, and take steps to return the lands where they had been to the prewar owners or occupiers. The sewage pump was removed from Ashley Road, and at all shelters it was ordered that fan mechanisms, sinks, taps, lavatory pans and light bulbs should all be recovered. Steel ventilation pipes were to be dug out, although this was not in fact done at Brighton Road and Godstone Road, where they are still in place. Other shafts, presumably emergency escape shafts at both Epsom shelters, were to be filled up.

After winding down operations, the War Emergency Committee for the Urban District Council for Coulsdon and Purley held its last meeting on 8 April 1946. The final meeting of the County Council's Special War Executive Committee appears to have been held on 16 January 1946.

The final Government approved cost of the Surrey deep shelters was £71,000, leaving the county's ratepayers to find the excess unauthorised expenditure of £17,267.

Later Uses of the Shelters

The abandoned Outwood Lane shelter was of course unusable, and its site has now melted back into the landscape.

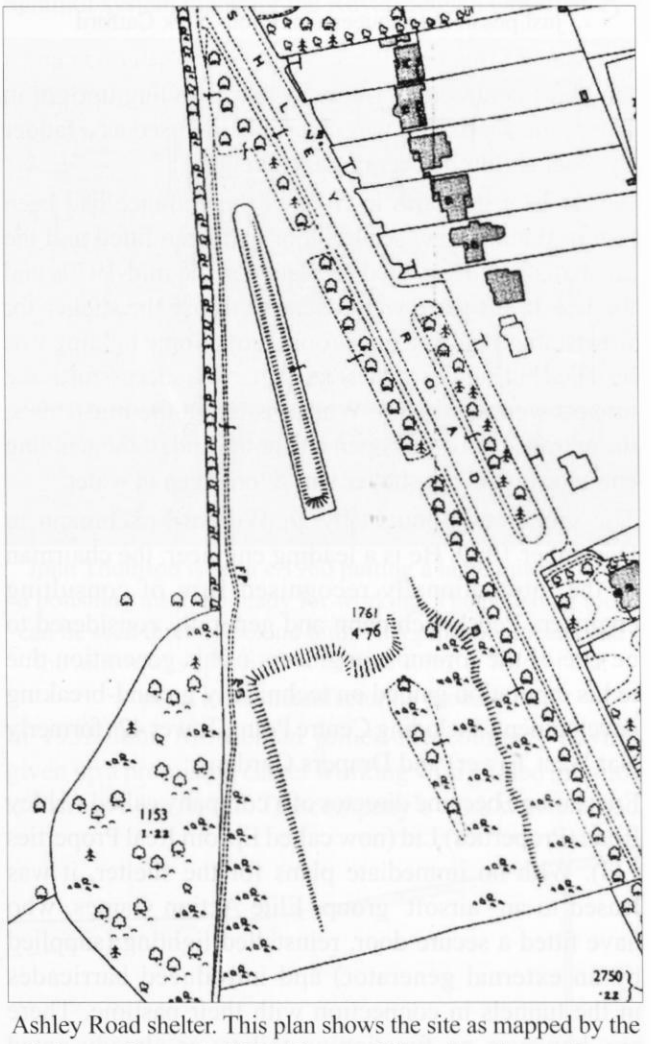


Longdown Lane shelter. This Ordnance Survey plan of 1954 misidentifies the access cutting as a chalk pit. It has since 1954 been landfilled, but led to a central entrance tunnel. The two quadrilateral enclosures at the northern and eastern corners are interpreted as emergency escape shafts which were presumably fitted with vertical iron ladders. They are believed to have been backfilled. The third such enclosure was presumably the ventilation shaft. There is no mapped evidence to suggest how foul water was disposed of at this site, which seems not to have been near an existing sewer.

At Longdown Lane the shelter appears to have had no postwar use. The cutting containing the entrance ramp was filled with scrap metal and builders' rubble in the 1970s and the area on the edge of Epsom golf course was allowed to return to nature. The golf club secretary was approached by Sub Brit member Keith Ward in 2004. Once made aware of the existence of the shelter, the golf club considered it could be used for storage and Keith was given permission to excavate the former entrance cutting to try and gain access to the shelter. (See *Subterranea* 8, September 2005).

The club secretary agreed to the use of a mini-digger and a team of volunteers assembled at the site one Saturday in the summer of 2004. Despite moving many tons of soil, rubble and scrap and a few small trees over the weekend, the entrance tunnel was not located by mid-Sunday afternoon and the hole was backfilled to make the area safe and the project was abandoned. The golf club were approached for permission to use a bigger digger. They were initially enthusiastic but later realised they didn't actually own the land and were unable to sanction any further excavation.

After nearly two days it had not been possible to locate the entrance and shortly after this picture was taken the area was made safe. Photo Nick Catford



Ashley Road shelter. This plan shows the site as mapped by the Ordnance Survey in 1954. The quadrilateral enclosure shown at the northeast comer is interpreted as the emergency escape shaft. The cutting leading to the main entrance communicates via a tunnel with the shelter tunnels themselves.

Ashley Road shelter

At Ashley Road access has been and still is possible, and local rumours that it had some Cold War use as a bunker may reflect some unfulfilled plans with that in mind. When visited by Nick Catford in 1975 earth had been bulldozed in front of the entrance although it was possible to get in through a small opening at the top of

By the 1970s earth had been bulldozed in front of the entrance at Ashley Road but in 1975 it was still just possible to squeeze in. Photo Nick Catford

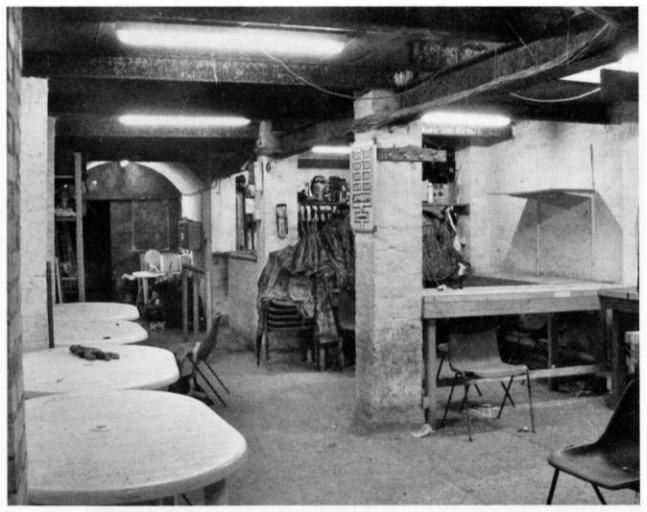
the door. At this time the air shafts were still open and a length of contractor's tramway was standing upright in one of the shafts and was clearly being used as a ladder by local children accessing the shelter.

A year later the earth in front of the entrance had been removed and a new secure door had been fitted and the air shafts had been filled in. Between the mid-1970s and the late 1980s there were attempts to use the shelter for wine storage and as a mushroom farm. Some lighting was installed but neither of these ventures was successful as the tunnels were too damp. When visited in the mid-1990s, the entrance door was open and at the end of the winding entrance tunnel the shelter was a foot deep in water.

The shelter was bought by Dr Willem Frischmann in December 1999. He is a leading engineer, the chairman of the internationally recognised firm of consulting engineers Pell Frischmann and generally considered to be one of the foremost engineers of his generation due to his reputation gained on technically ground-breaking developments including Centre Point, Tower 42 (formerly Nat West Tower) and Drapers Gardens.

Frischmann became director of a company called Ashley Road (Properties) Ltd (now called Epsom Real Properties Ltd). With no immediate plans for the shelter, it was leased to an 'airsoft' group, Elite Action Games, who have fitted a secure door, reinstalled lighting (supplied by an external generator) and introduced barricades in the tunnels in connection with their pastime. There are, however, no functioning toilets: as already noted the sewage ejector pump was removed after the war. Otherwise, fixtures and fittings remain more or less intact.

The *Epsom Guardian* reported on 17 January 2013 that planning permission had been granted to Dr. Willem Frischmann to convert this shelter into a 2,000-square-metre storage vault for gold and other precious metals. It appears that a number of banks have identified a need for additional secure bullion storage facilities. Nothing further has been heard of these proposals and at the time of writing it is still 'business as usual' for Elite Action Games.



At Ashley Road the canteen has been turned into their 'safe room' between games where players can have refreshment. and where all their kit and 'guns' are stored. Photo Mark Russell

Brighton Road shelter

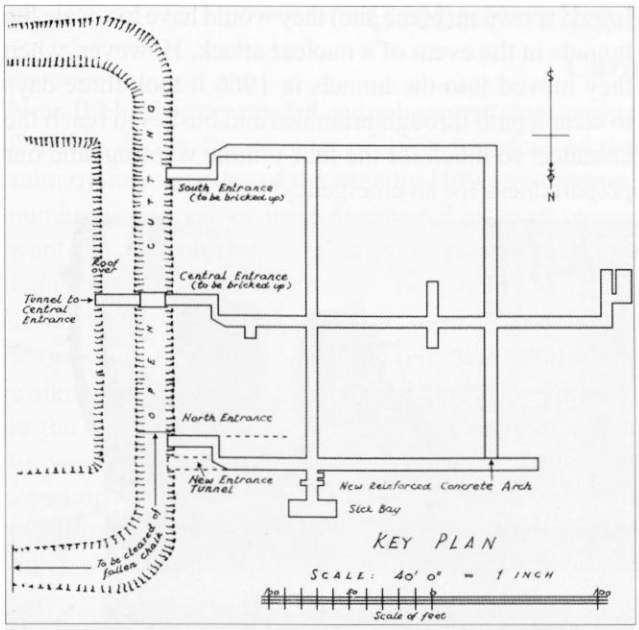
The Brighton Road shelter, along with the nearby former Cane Hill mental hospital, had a use in the 1950s as an underground optical factory, as reported by Roger Morgan and Paul Sowan in 2000 in *Bull. Subterranea Britannica* 31. Simon Cornwell, a former Sub Brit member, has located some published material relating to Cox, Hargreaves & Thomson Ltd's optical works, and interviewed persons formerly employed there.

From these sources it appears that an underground room on the north side of the tunnels was the location of a large glass-polishing machine capable of handling mirrors up to 80 inches in diameter. He has also located some details of alterations to the shelter made by the firm. The chicanes at the entrances were modified, and the south entrance was bricked-up.

An interesting feature of this shelter was that the main and two emergency entrances / exits were originally accessed from an excavated 'moat' along the front. The firm extended the main (central) entrance tunnel across the moat by way of a structure resembling a fortification caponier with a reinforced concrete slab roof, thus relocating this entrance closer to Brighton Road. A plan illustrating the modifications is reproduced here, and identifies the northern chamber as a sick bay.

John Thomson's memoirs tell us more of the early history of the Coulsdon optical works. From 1942–1944 F J Hargreaves was president of the British Astronomical Association (BAA) and made astronomical mirrors in his spare time. The high quality of his work was recognised by the then Astronomer Royal, Sir Harold Spencer Jones and other prominent astronomers and he suggested to F J Hargreaves that he should make it his full-time occupation. As a result Hargreaves agreed to give up his job as a patent agent at the end of the war and start his own optical company.

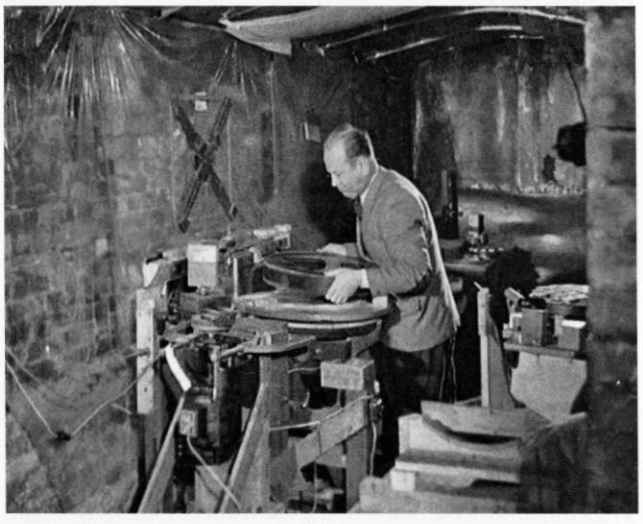
Having read a book on astronomy, John Thomson also joined the BAA and he soon was also making his own



This immediately postwar plan, probably made in 1948 or 1949 by F J Hargreaves, shows modifications required for converting the shelter into an underground factory for Cox, Hargreaves & Thomson Ltd. The northern emergency exit, modified internally, appears to be intended to serve as a main entrance, whilst the southern one was to be bricked up. What was intended for the original (central) main entrance is puzzling. It appears to be shown as to be 'bricked up' but, also, moved forward across the cutting (presumably in a built structure resembling a caponier) and a short new length of tunnel to new doors facing the car park. This would have been the most convenient point of access for moving bulky or heavy machinery and furnishings into the factory. The 'caponier' was certainly provided with a concrete slab roof and, presumably, brick side walls. Shelter lavatories (not shown) are thought to have been in the outer lateral tunnel, as at Godstone Road. The stub ends of the unfinished central lateral tunnel are shown, as is the chamber at the inner end of the shelter for the ventilating fan. The top of the approximately 18 inches diameter steel ventilating pipe can still be found in a clump of hawthorn bushes on the land above the shelter, although the conical rain shield was found to have been detached when last visited

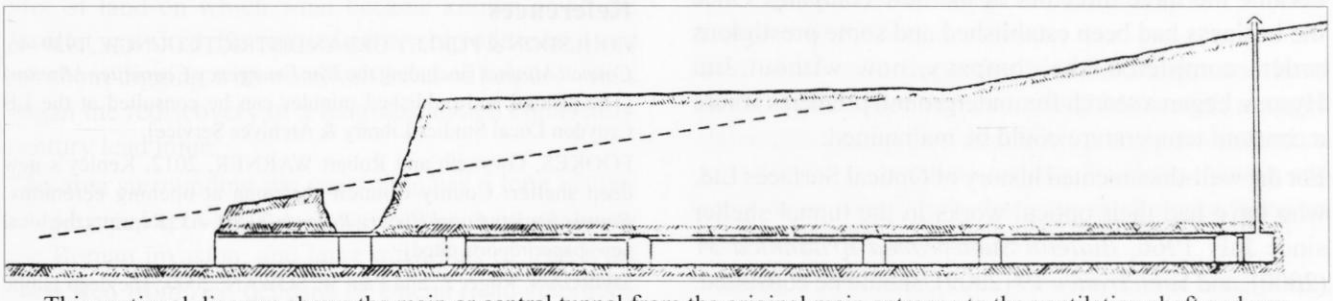
and Thomson (H W Cox never actually joined the firm despite the new company including his name and John Thomson didn't join the firm until 1950) was founded in Hargreaves' home town of Coulsdon with a workshop in Brighton Road, Coulsdon. This was located in a former WWII surface air-raid shelter where three garages had been knocked into one and the walls and roofs reinforced.

The fledgling company won orders from the likes of the Royal Greenwich Observatory and the Mt. Stromlo Observatory in Australia. This workshop soon proved unsuitable as there was a clear need for temperature control. To achieve this, the company took over the deep shelter in 1951 where the temperature was maintained at a constant 54° F throughout the year. It is here that the optics for many medium-sized telescopes were completed, including a Schmidt system made for the Royal Belgian Observatory.



John Thomson is seen c.1960 putting a large mirror onto a polishing machine ready for working. The polishing tool can be seen directly behind him. That probably means that the mirror was spherical in surface form, at least at that point in the manufacturing process

In 1955 John Mortleman joined the company having given up a promising career working with guided missiles at Fairey Aviation Ltd. The company's work was featured



This sectional diagram shows the main or central tunnel from the original main entrance to the ventilation shaft and was prepared with the plan above. As at the two Epsom shelters, additional protection has been provided for the shallower (eastern) two thirds of the shelter by depositing excavated chalk above them. The dashed line shows the original ground level

astronomical mirrors. Having heard of Hargreaves' plans to start his own company he offered to join the planned company and was quickly accepted.

H W Cox was an amateur optician and with his brother made the first Schmidt camera in the UK. He also offered to join the company and in 1947 the firm of Cox, Hargreaves

in a short Pathé news feature film in 1960. By 1961 the initial enthusiasm had waned and it was felt by Mortleman and Thomson that the company could only progress if radical changes were made in management. These were rejected and Mortleman and Thomson resigned from the company with a plan to set up their own business, Optical

Surfaces, This they did on 13 April 1962 with premises in Stoats Nest Road in Coulsdon.

Cox, Hargreaves & Thomson remained in business but working in the cold and damp conditions of the shelter was asking too much and during the 1960s the company vacated the tunnels leaving some of their equipment still in situ. The London Road shelter was then leased to Optical Surfaces but the tunnels were only used for storage. When the shelter was visited in 1975–6, the lights were inoperative, the door partially jammed and the remaining machines unusable. F J Hargreaves died in September 1970 and Cox, Hargreaves and Thomson Ltd was wound up on 12 October 1978. After the factory was abandoned, part of it was used as a storage place by a local garage. Abandoned tools and tool racks support this.

There is still a huge quantity of rubbish in the Brighton Road tunnels; this view is from 2013. Photo Mark Russell

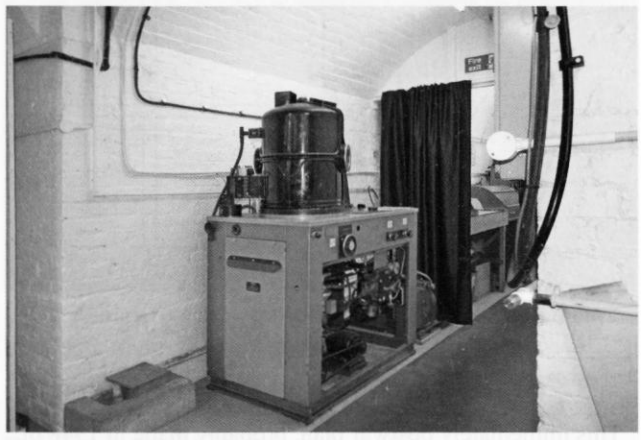
The Godstone Road shelter, the most successful of the four, was reputedly used, perhaps by James Geary Gardner of Chislehurst Caves, for mushroom culture, but no primary records of this enterprise have been located to date.

John Thomson's memoirs tell us more about the early years of Optical Surfaces. The two former directors of Cox, Hargreaves and Thomson and a third member of staff Jim Hysom, who had walked out in sympathy, became the three directors of the new company. Once the business had been established and some prestigious orders completed, the company, now without Jim Hysom, began a search for underground premises where a constant temperature could be maintained.

For the well-documented history of Optical Surfaces Ltd, who have had their optical works in the tunnel shelter since July 1966, *Bulletin Subterranea Britannica* 31 (2000), and *Subterranea* 19 (2009), should be consulted.

Later use

Whilst there is little doubt that the authorities and emergency planning officers were aware of the four bunkers, and may tentatively have had their use in mind during the Cold War, it is clear that none of them was adapted for emergency use during that period. One of the directors of Optical Surfaces informed me that as a condition of the firm's lease from the City of London (postwar owners of the site) they would have to vacate the tunnels in the event of a nuclear attack. However, when they moved into the tunnels in 1966 it took three days to clear a path through brambles and bushes to reach the entrance: so much for the four-minute warning, and our preparedness for an emergency!



Coating machine left behind used to deposit a thin film on optical surfaces. This performs the same function as the machine left behind in the Coulsdon deep shelter by Cox. Hargreaves & Thompson Ltd. (illustrated on page 37). It is newer but not much! November 2013. Photo Nick Catford

Suggestions for Further Research

The SWEC records refer to various documents, such as wardens' reports, that are not contained in the files. Copies may possibly survive elsewhere. No registers of regular shelterers have been found. No statistics for shelter usage have been found, and it is therefore not possible to assess how many lives may have been saved or serious injuries avoided.

The most fruitful line for future research would probably be other County Council records relating to engineering questions, land ownership and leases, and personnel. The wartime records of Epsom & Ewell Council would be worth searching. And local newspapers could be combed for events for which specific dates are known.

References

COULSDON & PURLEY URBAN DISTRICT COUNCIL, 1939–46, *Council Minutes* (including the *War Emergency Committee Minutes)* [The printed and published minutes can be consulted at the LB Croydon Local Studies Library & Archives Service]

FOOKES, Gwyneth and Robert WARNER, 2012, Kenley's new deep shelter: County Council chairman at opening ceremony. *Bourne Society Local History Records* 70, 61–63 [Reprints the local newspaper reports cited]

MORGAN, Roger J., and Paul W. SOWAN, 2000, The deep public air-raid shelter and underground optical works at Coulsdon, Surrey. *Bull. Subterranea Britannica* 31, 5–10.

SOWAN, Paul W., 2009, The World War II deep air-raid shelter at Kenley, London Borough of Croydon. *Subterranea* 19, 50–55.

SOWAN, Paul W., 2013, Planning and construction of Surrey County Council's five World War II deep tunnelled air-raid shelters and related subsurface schemes. *Subterranea* 33, 39–56.

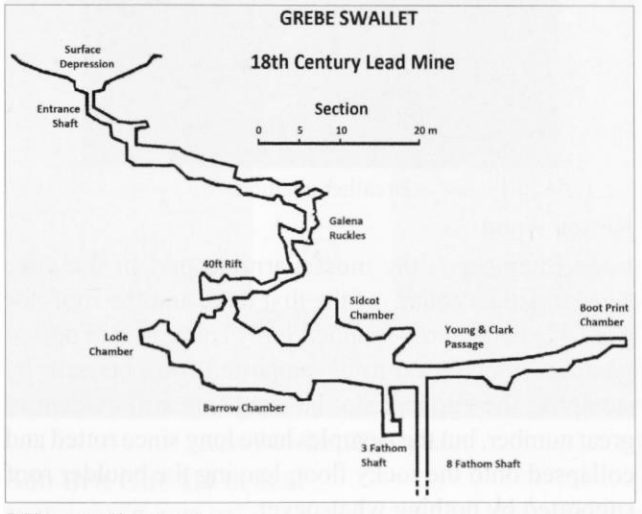
SURREY COUNTY COUNCIL SPECIAL WAR EXECUTIVE COMMITTEE, 1939–1946 [Records can be consulted at the Surrey History Centre at Woking / reference CC 767/52/1–15]

Grebe Swallet Revealed, Somerset

Chris Binding

Near-Biblical heavy rainfall and subsequent catastrophic flooding during the summer of 1968 transformed the subterranean tapestry of the Mendip Hills in Somerset; numerous new caves were discovered as local cavers went out looking for swallets (surface stream sinks) indicating likely digging sites – one such was Grebe Swallet.

Shortly after the storm had passed, Tom Elkin was walking his dog on the old mining landscape adjacent to the Charterhouse Outdoor Pursuits Centre of which he was then the Head. Insistent barking called his attention towards a ponded depression where a grebe was paddling. Tom recalled that suddenly the water spiralled into a whirlpool and promptly drained away. His caving connections soon got word of this and duly noted the site (as a potential inlet to an otherwise unknown cave) for future consideration.

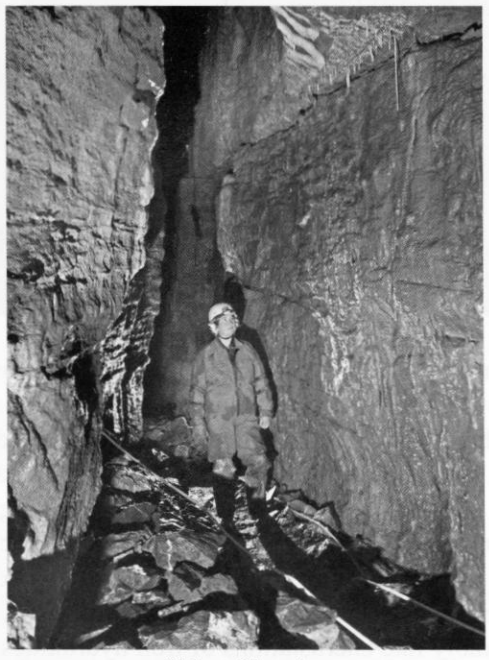


Mine rediscovery

Over fifteen years elapsed but memories are long and pioneering Mendip cave digger Dr Willie Stanton had the presence of mind to attend an auction of the small plot of land on which what became known as Grebe Swallet was sited. He secured ownership of the land and set about digging with a stalwart band of helpers – thus began the rediscovery of a long-abandoned eighteenth-century lead mine.

The area surrounding the cave/mine has a long history of industrial activity, some excavations even predating the Roman invasion, and large quantities of lead were harvested from rich deposits of galena (lead sulphide), much of which was naturally deposited near the surface thus making for easy and rich pickings.

During the course of many years and hundreds of digging trips, painstaking efforts saw flood sediments being dug out of Grebe Swallet and boulders stabilised with cement. A circuitous passage, with many dead-ends en route, was opened to a forty-foot-deep natural rift – not wide, but



Sidcot Chamber

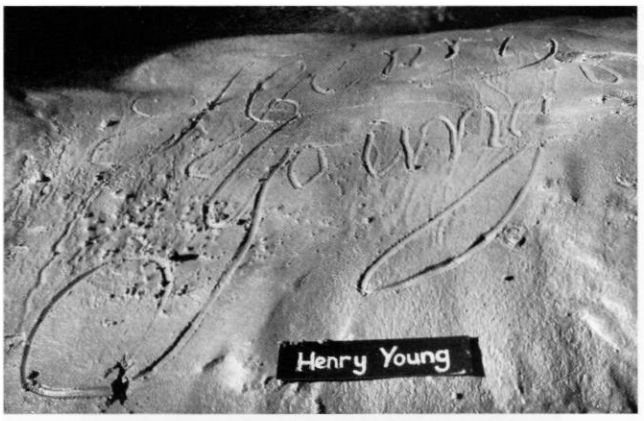
sufficiently deep to impress. For an experienced caver this was a straightforward climb, assisted with a hand line for the less sure-footed, and a short stooping walk opened up into a chamber – named Sidcot Chamber by Willie Stanton in recollection of his schooldays (Sidcot School Speleological Society was his Hadean alma mater).

Plenty of mining evidence

Sidcot Chamber had the hallmarks of previous workings and numerous man-made tell tales, including miners' artefacts – discarded hobnail boots, long since rotten, rusty and perished; sharpening stones with chisel marks; collecting grooves in the flowstone walls to direct and capture water; stones of galena (lead sulphide) stacked ready for removal to the surface; areas of robbed-out stalactites perhaps for keepsakes or potential sale to visitors to nearby Cheddar Gorge; boot prints in the mud; and egg and slot housings for the still *in-situ* wooden stemples (props).

Best of all were the etched doodles, finger and hand prints, and scribed names in mud banks with snapped stalactites nearby that had been conveniently used as a stylus for copperplate writing by Henry Young and companion John Clark, the icing on the cake being an actual date – 20 November 1753.

Judging by the small size of the finger and hand prints, Henry and John were children, probably sufficiently educated to write their names and the date but otherwise not very literary inclined. The writing is believed almost certainly to coincide with the last phase of mining activity (since it was not obliterated by subsequent working). Trail marks in the clay are testament to an influx of small creatures which must have hitched a ride on the miners' garments!



Henry Young's graffiti

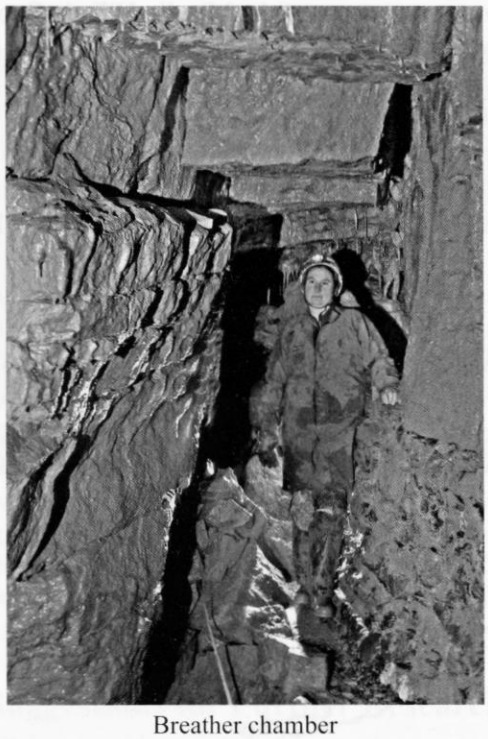
The miners were extracting galena – here deposits of near-pure lead – in a variety of forms: "smitham" – smoothly rounded ore granules, gravel-like, in sediment banks, and "stones" – some in excess of 10cm diameter and in slabs of up to 23kg. These slabs are roughly of uniform thickness patterned on one side, with convex lumps and irregular hollows on the obverse, and have similar characteristics to hydrothermal deposits, being remarkably like encrustations of iron hydroxides at the not too distant Roman spa in Bath.

Complex geology

Although Grebe Swallet has been exploited for its minerals it is more accurately defined as a cave, and geologically it is localised following the strike of two adjacent Neptunian dykes. These vertical fissures, or rifts, were seismic in origin and cut through the strata of the sea bed to become infilled with sediments washed into them. In Grebe Swallet the dyke infill takes a variety of forms – from angular clasts of Carboniferous and Triassic limestone in a matrix of bright yellow Liassic ochre to grey granular sediment in which double-pointed dog's-tooth calcite crystals have grown. There is also coarse-grained grey/brown limestone packed with crinoid and shell fragments, the latter containing dispersed cubes of galena up to 6mm in width. The twin adjacent dykes of Grebe Swallet are of unascertained depth but may be in the region of 100m.

For all its short length, the cave has variety; today's entrance, made of vertical concrete tube sections of around 3m, slopes through consolidated boulders into a standing chamber with parallel walls – the first of the aligned dykes – both of which run NNW to SSE. A short laddered climb leads to a continuation of the dyke but it narrows, and egg and slot marks indicate that miners were here. This is almost directly above Lode Chamber, deeper in the dyke, and may have been the original way in. The modern route breaks left and enters the Galena Ruckles, a convoluted stabilised route through a three-dimensional boulder maze spiralling almost vertically towards the top of the forty-foot rift, which is the lower extension of the first dyke.

An exposed climb is facilitated by useful ledges (or rope), and the near-horizontal bedding contains chert protrusions and hence represents a change in localised geology; the base of the climb has a stone staircase descending to a flat-roofed chamber leading left, to Lode Chamber on the one hand, or Sidcot Chamber straight ahead.



Breather chamber

Rotten wood

Lode Chamber is the most alarming part of the cave since it is the "cellar" of the first dyke and the roof, for want of a better term, is unnervingly comprised of poised boulders which used to be supported from beneath by stemples; the egg and slot housings are still evident in great number, but the stemples have long since rotted and collapsed onto the rocky floor, leaving the boulder roof supported by nothing whatsoever.

It is believed that the miners originally gained access to their workings via a route which has since run in; the run-in is probably the reason why the boots, sharpening stones and uncollected stones of lead remain *in situ*, the bother of re-excavating the collapse being too great in comparison to the rewards.

Sidcot Chamber, on the other hand, is pure cave with mining additions (the artefacts previously mentioned), with two shafts driven into the floor – one mid-chamber, circular and lined, the other at the end of a calcited pinch-point going straight down fifty feet with stacked deads on one side. These stacked deads were originally built on wedged stemples, the rotting remnants of which reside at the base of the shaft – mildly alarming evidence providing pause for thought after abseiling to the bottom. The walls of Sidcot Chamber are thickly coated in pristine flowstone and at the far end rise up to a well decorated grotto, untouched in a quarter of a millennium.

One side of the chamber has drystone walling holding back the extracted rocks from the two shafts, with large

blocks forming the perimeter wherein shot holes can be seen – matching shot holes are visible in the mined shafts and these must have been driven by hand; the effort involved would have been considerable.

A generous side passage strikes away at forty-five degrees from the dyke into an adjacent, narrower dyke, which comprises Young Clark Passage and Bootprint Chamber – this was the extent of the mining activity and no galena appears to have been located here. There's plenty of evidence of stalactite-gathering, with long-since broken flowstone having regrown over the subsequent 260 interim years. In the clay floor is the eponymous miner's footprint.

New lid with SB plaque

Sub Brit Gift Aid benefit

Following Sub Brit's successful application for Gift Aid from HM Revenue and Customs on our subscriptions, the Committee decided in 2011 that some of this money should be used towards new activities and worthy projects be they for research, restoration or publication. A number of applications have since been received, including a request for a grant to replace a 40-year-old (rusting) metal lid approaching the end of its useful life at Grebe Swallet. The Committee considered this to be a worthy project and awarded a grant of £500 which was gratefully received.

Local cavers prepare to descend into Grebe Swallet after the new lid has been fitted

The cave is locked but access is freely granted to experienced cavers and capable interested parties. It is subject to a conservation warden system of three people plus leader so that the artefacts remain preserved and can be interpreted en route.

Photos by Ed Waters

Further information:

University of Bristol Spelaeological Society Proceedings: *Lead Ore in Grebe Swallet Mine, 1991*. W.I. Stanton

www.ubss.org.uk/resources/proceedings/vol19/UBSS_Proc_19_1_43-65.pdf

Grebe Swallet: Mendip Underground, 5th Edition, publication due end 2013.

See also www.charterhouseminingreserve.org.uk/

Access info: www.cscc.org.uk/access

Subterranea Britannica Study Weekend
Prague : 9-12 May 2014

We are planning a trip for Sub Brit members to Prague and the surrounding area, in the Czech Republic

The list of sites will include underground bunkers and the Metro in Prague, along with mines and quarries and other interesting subterranean places

There is more detail on the flyer included in this copy of *Subterranea* if yours is missing and you'd like to know more, please contact us at info@subbrit.org.uk

A very short and remarkably interesting railway tunnel at Haywards Heath, West Sussex

Paul W. Sowan

From Haywards Heath station it is possible to look southwards through the very short (250 yards) single bore double track Folly Hill tunnel, one of several 'bottlenecks' which severely restrict capacity on the main London to Brighton line (most of the line is of four tracks, other than at the Ouse Valley viaduct and some other tunnels).

Members who attended the recent Sussex Study Weekend may remember the former chairman becoming quite animated on finding a watercolour on display in the museum at Cuckfield. This was a view, painted by one George Childs, of the railway during construction at Haywards Heath (to which station the line opened on 12 July 1841). It shows what is now the view southwards from the station along the cutting to the tunnel's north portal, but includes details of how the cutting was made and of men at work. Two details are particularly interesting. Firstly, there are 'barrow runs' shown, giving the impression that the spoil dug to make the cutting was taken up the steep cutting sides rather than (gravitationally) down to the line for removal by rail to make an embankment further north, which would be the usual and energy-efficient approach. Secondly, what is certainly one and possibly a second brick tower can be seen on the hillside above the tunnel. There are in fact two brick towers still standing today very close together and easily seen either side of Muster Green South (the A 272 road). Both presumably protect what are erroneously called 'air shafts' but should be named from their primary purpose 'spoil extraction shafts' (tunnels are often largely excavated from two or more working faces advancing from shaft bottoms inside the hill). But for such a short tunnel, usually no shafts at all would be used, it being sufficient for the tunnel to be driven only from the two ends.

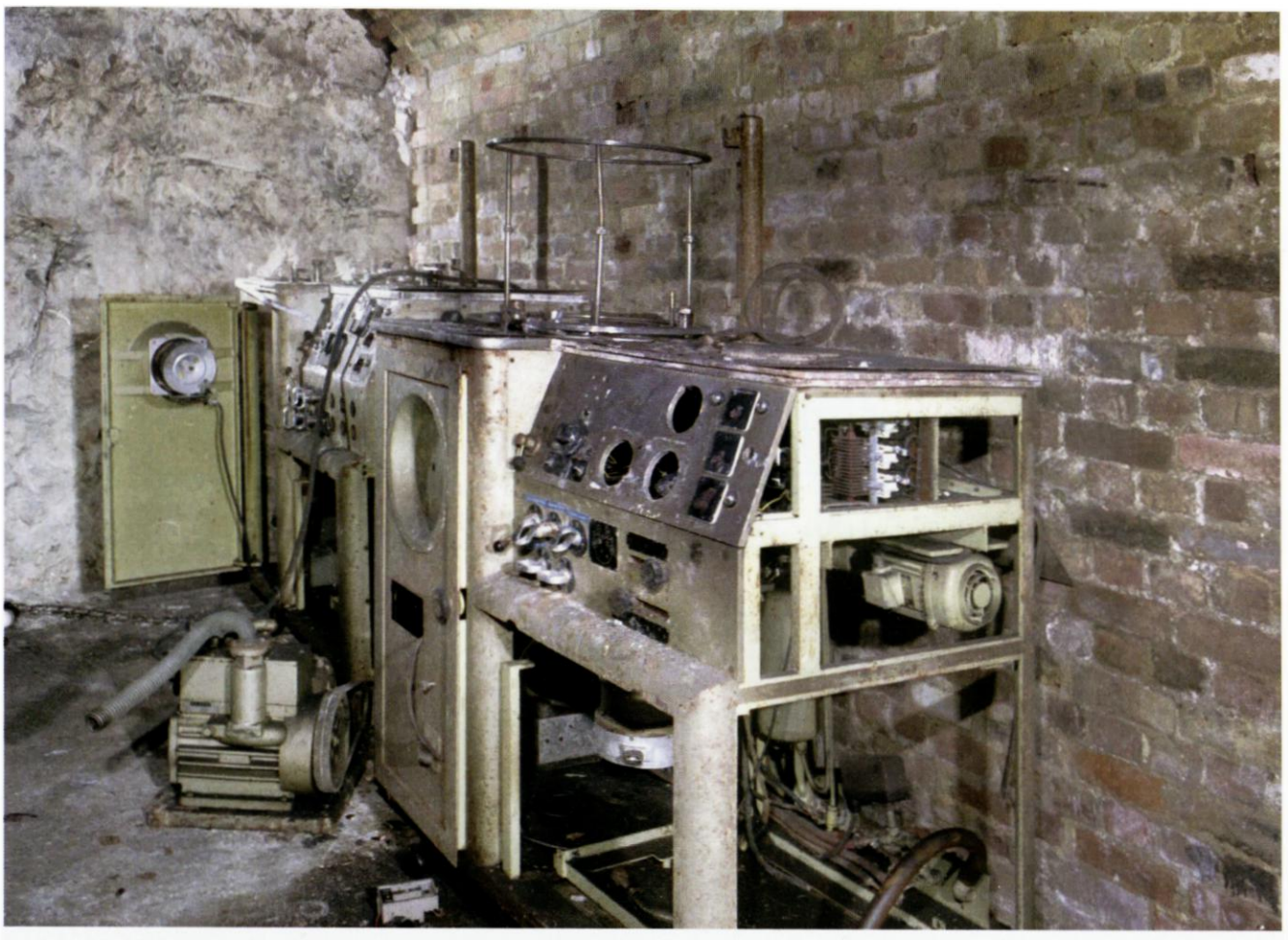
Mystified, I took the train to this otherwise not remarkably interesting town and walked from the station up Perrymount Road and turned right at the top to view the two brick towers. This immediately posed the next question: where was the spoil taken from the cutting, and raised in the shafts, actually dumped? A 250 yard double-track rail tunnel would yield somewhat more than 16,000 cubic yards of spoil to be disposed of, which would make quite a heap! To this would be added more from the shafts and even more from the cutting at either end. There is no sign of it alongside the line back towards the station! Where has it gone? There wasn't really any town at all here until development followed the opening of the railway and, especially, of the Surrey County Asylum nearby in 1859, and it seems doubtful that the spoil might have been used straight away locally for building materials.

Helpfully, the same artist also painted the view southwards from above the south portal of the Folly Hill tunnel, also during construction, showing a long deep cutting, and more barrow runs. The original of this is held by the Museum at Brighton. Barrow-runs are best known from the much more famous painting by J.C. Bourne of the cutting northwards from Tring on the London to Birmingham line. A horse-worked winding engine, if Bourne's painting is to be believed, hauled barrow-loads of spoil up steeply sloping planks of wood laid up the side of the cutting, each barrow being steadied by a man behind it holding the handles. It looks remarkably dangerous!

The next mystery is the name of the tunnel, Folly Hill. The ground under which it was driven is called Muster Green, not Folly Hill. Perhaps the tunnel name derives from geological problems encountered by the contractors making the cuttings and tunnel? The railway company chose to take the line this way, between the two existing settlements of Cuckfield and Lindfield, presumably to reach Brighton by the shortest possible route, and perhaps to serve both villages at approximately equal distances. An earlier intended route via Cuckfield was in fact abandoned to that end. Work at the tunnel delayed opening southwards until over two months later, 21 September 1841 to be precise.

Thus I find myself opening another research project, with the next move an examination of the geological and engineering records for this part of the railway.

Parts of both of George Childs' paintings have been published in a book '*Haywards Heath through time*' by Colin Manton published by Amberley Publishing in 2013.



Coating plant left behind by Cox, Hargreaves & Thomson Ltd when they vacated the Coulsdon deep shelter. This was used to deposit a thin film on optical surfaces. Photo Nick Catford

Smoothing machines in the Optical Surfaces factory at Kenley. The optics are first ground to shape and profile on standard milling machines. After that the optically active surfaces are worked with a loose slurry of corundum. Photo Nick Catford

At Fan Bay, some tunnels through loose chalk are lined with curved corrugated-iron sheeting as seen here. Through more stable ground (through the doorway), the tunnels are unlined. Photo Nick Catford

Members inspect the underground control room within the underground complex at Säve (SÄV) in Sweden. All functions of the above ground control tower are replicated here. Photo Clive Penfold

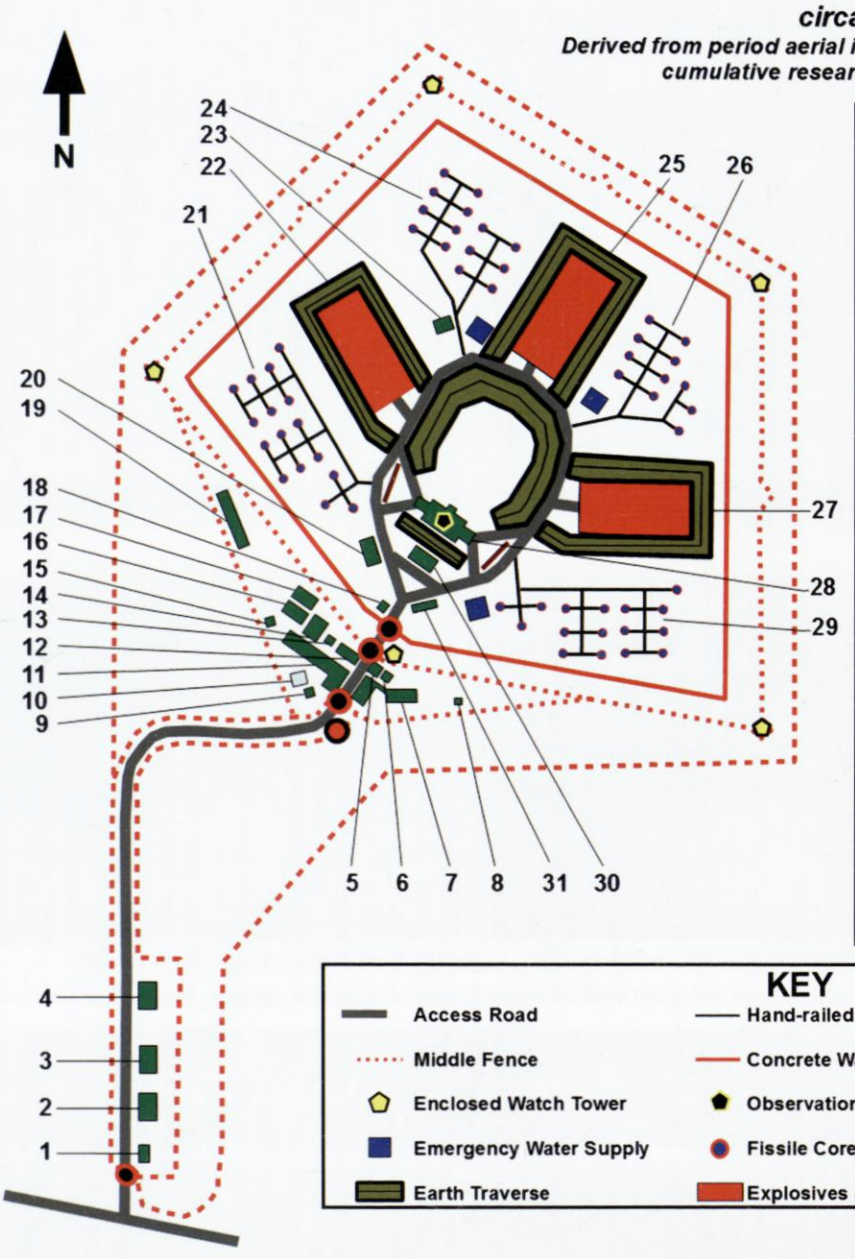
Most of the plant at Daws Hill was located in narrow corridors. This is a pair of filter rooms. Photo Nick Catford

The remains of wooden benches along the side walls of the deep-level Ellington School shelter at Ramsgate. Photo Nick Catford

RAF BARNHAM 'TOP SITE'

circa early-1960s

Derived from period aerial imagery, Air Ministry diagram 3001/53, cumulative research and current ground evidence.



1 Outer RAFP Picket Post
2 Vehicle Storage Bldg
3 Generator/ Power Bldg
4 Generator/ Power Bldg
5 Small Generator/ Power Bldg
6 Possible Generator Fuel Compound
7 Main Administration Bldg
8 Pyrotechnic Storage Bldg
9 Pump House Bldg
10 Enclosed Ground-level Water Tank
11 Guardroom/ NAAFI/ Amenities Bldg
12 Original Fire Engine Shed
13 Communications Bldg
14 Accommodation Bldg
15 Dog Food Preparation Bldg
16 Gymnasium
17 Mess Bldg
18 RAF Police Inner Picket Post
19 Dog Kennels
20 Inspection & Repair Workshop
21 Western Core Storage Area22
Western Explosives Storage Bldg
23 Probable Core Inspection Bldg
24 Northern Core Storage Area
25 Northern Explosives Storage Area
26 Eastern Core Storage Area
27 Eastern Explosives Storage Area
28 Maintenance & Repair Bldg
29 Southern Core Storage Area
30 Probable Equipment Store
31 WC Block (moved since 1955)

KEY

Access Road	Hand-railed Footpath	Outer Fence
Middle Fence	Concrete Wall	Vehicle Gate
Enclosed Watch Tower	Observation Point	Pedestrian Gate
Emergency Water Supply	Fissile Core Storage Bldg	Support Bldg
Earth Traverse	Explosives Storage Bldg	

Unrestored watch tower at RAF Barnham. Photo Nick Catford

A floor safe for a fissile core is demonstrated by Squadron Leader Simon Treacy at RAF Scampton. This is identical to the fissile core safes at RAF Barnham. Photo Nick Catford

The Powerful Past of a Suffolk Industrial Estate – Preserving a Nuclear Storage Site

Sam Tolley

Few people on my recent path of investigation have heard of RAF Barnham in Suffolk. Locals might know it as the current RAF training area and the older generation might even have heard the rumours about how one part of the camp was involved with training chimpanzees for the UK's early space programme...

Fewer people know that RAF Barnham served the RAF V-bomber bases of No 3 Group during the late 1950s and early 1960s, acting as a major storage and servicing depot for the UK's first production nuclear weapon, the *Blue Danube*.

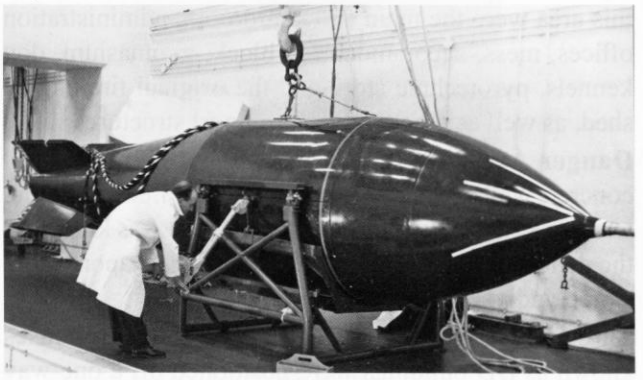
History

During the 1950s a requirement was placed to build nuclear-bomb storage depots to support the RAF stations set to become home to the V-bombers. Two such depots were constructed, one at RAF Faldingworth in Lincolnshire and the second at RAF Barnham, the latter already in use as an ammunition storage depot and a World War II chemical weapon store and filling station. Barnham, just south of Thetford, provided direct nuclear weapon support to RAF Cottesmore, Honington, Marham and Wittering.

Barnham's 'Top Site', as the nuclear element was known, reportedly cost in the region of £1.5 million to build and became operational circa 1956. In what was to be a relatively short lifespan the site had become redundant by 1963, when its security status was downgraded and the overhead flight bans lifted. Changes to military doctrine and the storage requirements for the newer nuclear weapons brought about Barnham's demise. Just ten years after becoming operational the site had been sold off to a young entrepreneur and his wife at auction for the very reasonable sum of £20,000.

My Involvement

My interest in Top Site began after the owner of the site, Keith Eldred, kindly showed me around his property early in 2013. After taking many photographs on this visit and wanting to do something useful with them, I created a relatively small website documenting the site as of March 2013. Eight months later, I feel that it is now a comprehensive history of the site, fuelled by personal accounts, official records and my own analysis.



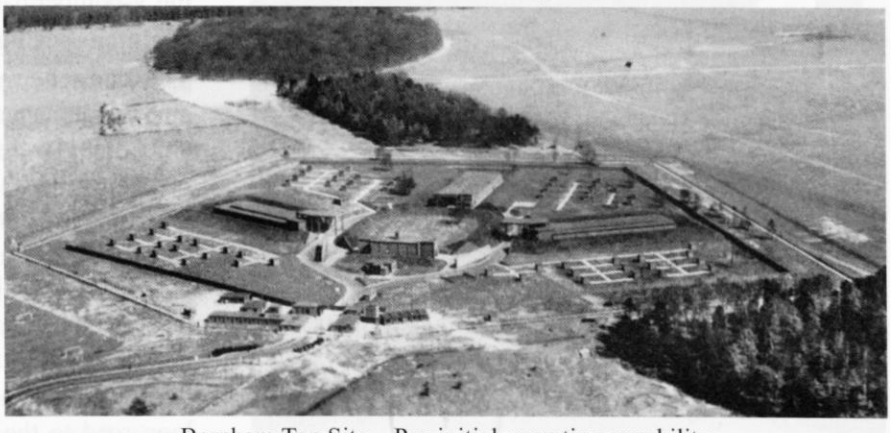
Blue Danube Bomb. Crown Copyright

As an independent hobbyist I have found the research extremely rewarding, interviewing former site staff, utilising the RAF Museum's Research and Information Services department at Hendon and trawling many websites, forums and books. Where possible I have been corroborating the information received to provide a more accurate history than currently exists. I have become all too aware of circular reporting caused by some of the lesser accurate (and sometimes mostly fictitious) material that has been produced and its effect on other subsequent sources.

Site Breakdown

Top Site comprised three main areas: an outer support area, an administration and inner support area and a 'danger area'. The main part of the site is pentagonal in layout and there appears to have been no attempt made to disguise it from aerial reconnaissance, perhaps making a deliberate political statement to the Soviet Union that we were stockpiling nuclear weapons.

The Outer Support Area – This contained the outer RAF Police picket, two generator/power buildings and later on a probable fire station/vehicle storage shed. One member of the site staff recalled how the engineers would bring their electric floats down to these buildings to charge overnight. This area was accessible from the Elveden to Barnham Road, which joins the A11 with the A134.



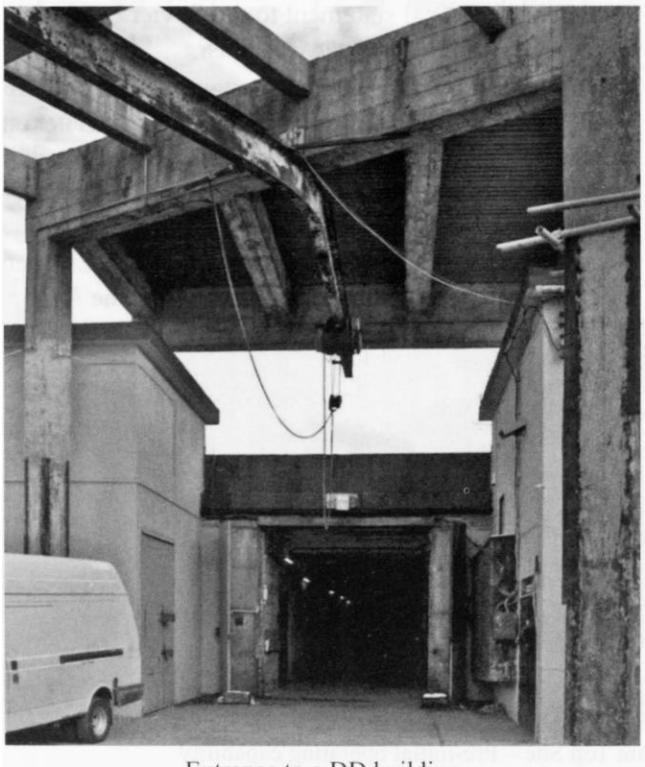
Barnham Top Site – Pre-initial operating capability April 1955. Crown Copyright

Administration and Inner Support Area – This element is located some 350 yards along an access road within another layer of security fencing, accessible via a personnel turnstile and large sliding vehicle gate. In this area were the main site guardroom, administration offices, mess, accommodation block, gymnasium, dog kennels, pyrotechnic store and the original fire engine shed, as well as other ancillary support structures.

Danger Area – Within a pentagonal eight-feet-tall concrete wall and accessible via a single sliding gate and another RAF Police picket post was what was known as the danger area. This is where the atomic weapons were stored and maintained.

Three large open-plan concrete storage warehouses known as DD buildings were positioned off a one-way loop road originating from the danger area entrance. These buildings measured 58m long by 18m wide, each with a large concrete gantry and crane. The DD buildings were initially responsible for handling and storing the 24-foot-long, 10,000 lb *Blue Danube* bomb, later doing the same for the smaller *Red Beard* weapon. The bombs were kept on their airfield bomb transporters in a state of readiness so that they could be taken in convoy out of the site in the shortest time possible in order to resupply the V-bombers for any second strike missions, as optimistic as that might have been at the time.

The buildings are flanked on three sides by large earth-traverses, with a large U-shaped traverse to their frontages, all designed to limit the across-site damage should one of the buildings suffer an internal explosion – plausible as the weapons contained high-explosive in order to make the plutonium cores critical for an atomic explosion.



Entrance to a DD building

The fissile cores were stored separately from the main part of the bomb for safety reasons. They were kept in specially designed and separated brick-constructed fissile core storage buildings. These were locally known to the site staff as 'igloos', possibly picking up the American term for a different, but nuclear-storage-related structure. The structures have also been listed as 'hutches' at other sites and this may have also been a locally accepted term for them.

Fissile core storage buildings

A total of 57 of these buildings are at Barnham, separated into four groups surrounding the large DD storage buildings. Forty-eight of these structures contained a single metal safe for storing a single core and were known as AD buildings. The other nine contained two safes and were known as BD buildings. At present we can only speculate why these nine had two safes. Both the AD and BD structures featured a wooden-backed but metal-fronted door, secured with a manifoil (combination) lock.

The buildings were electronically linked back to the main guardroom to alert the RAF Police if a door were opened. It has been reported that no one-man could access a fissile core, with one person being responsible for the door combination and the other having the key to the safe.

The exact number of *Blue Danube* bombs that were in service has not yet been determined, however, it is believed to have only been in the tens rather than the planned 800. As a result it is unlikely that Barnham's fissile storage capacity limit was ever reached, especially when additional storage existed at Faldingworth and at the V-bomber bases.

Maintenance Facilities

The danger area also contained several servicing and maintenance buildings in addition to three large emergency water tanks and a toilet block. The core inspection (MD) building had an integral core safe built inside it and like the core buildings featured a manifoil lock on its door. This structure was protected by brick blast walls on the sides facing the DD buildings, presumably to shield it from explosive blast. It is located near to the AD and BD buildings to the north of the site.

An inspection and repair building is located just off the loop road to the left as you enter the danger area. Its operational function is currently unknown, although it

could have been related to servicing certain elements of the bombs that weren't fissile or explosive-related such as the nose electronics or tail components, the latter of which featured flip-out fins on *Blue Danube* due to the space limitations within the V-bomber bomb bays. Interestingly it isn't listed on the architect's diagram along with the other buildings, suggesting it was a later edition.

A large high-bay maintenance building (CD) is located to the front of the danger area entrance, with direct road access to the eastern and western DD buildings. This building is also surrounded by its own earth-traverse and substantial blast walls. It has been reported that the building featured air locks at either end, although it is probable that these were a security feature rather than for a clean-air environment. An annexe to the building is reported to have had an X-ray machine inside and so with all these features it is likely that this building serviced major components, if not the main explosive elements, of the bombs.

A smaller storage building is to the front of the CD building, directly in front of the danger area entrance. This ED building was possibly where the danger area's support equipment, such as trolleys and tools were stored and/or maintained. I have been told by the site owner that this building was totally shielded with chicken-wire in the ceiling and had a separate screened 'cage' inside it when he took over the site. What this may have been for is still unknown – speculatively it does bear some resemblance to the principle of a Faraday cage which is a way of protecting electronics against the effects of an electro-magnetic pulse, a feature that occurs during a nuclear detonation.

Security

RAF Police. Security responsibility lay in the hands of the RAF Police, split between Station and qualified police dog elements. In addition to RAF Police Officers and Warrant Officers that provided overall security, it has been reported that up to fourteen RAF Police personnel were on shift, including the Duty Sergeant, Duty Corporal and the rest made up of full-time or National Service corporals, none of whom lived on site. Eight to ten dog handlers were accommodated at the site with their animals in the co-located kennels.

Watch Towers. In addition to the double fencing and concrete wall, other stand-out security measures were in place. Initially, five 15ft-high open-topped wooden watch towers were positioned around the inside of the middle fence perimeter, with a single wooden emplacement placed on top of the CD building. In 1959, all bar the latter structure had been superseded by much taller enclosed metal towers, featuring heating and two searchlights each. This was no doubt an appreciated enhancement for the RAF Police manning the towers during adverse weather.

Sterile Areas. The area in which the watch towers were positioned, between the concrete wall and middle fence

A restored watch tower

line, was classed as sterile. It featured a small path joining the towers together and allowed the patrolling RAF Police to walk the inner perimeter. Telephone reporting points were positioned between the towers along with V-shaped cut-outs in the fence line, designed to aid the foot patrols in looking up and down the outside of the wire fence. The area was lit by regularly spaced lamp posts.

If personnel were to venture from the narrow path they would run the risk of tripping one of the many Mark II flares, substantial devices about three inches wide and five inches long that were distributed among the grass. The same flares were also atop the concrete wall among spools of barbed wire. Should an intruder still not be deterred by all this, the RAF Police were armed with pistols and at night the RAF Police dog teams were on patrol.

Security Incidents. No known nefarious security breaches are thought to have occurred, however, HQ Provost and Security Services mounted regular mock entry attempts onto the site, either via false documentation or by physically defeating the security features. Only once is it reported that one of them did make it into the danger area, but he was apprehended quickly enough for him not to be able to pose a credible threat to the stores. It has also been detailed by one RAF Policeman that the Campaign for Nuclear Disarmament conducted a protest at the site, with their members trying to scale the outer fences, only to be repelled by the Station's fire-engine hose.

Nuclear Convoys. An additional group of RAF Police, known as X-Flight, handled the convoys from Barnham to the V-bomber stations and weapon-component production facilities. They were split into two teams of around seven men, detailed Red and Blue section, and fell under the command of one of the site's Equipment Branch officers that acted as the convoy commander. *Blue Danube* was moved in a large trailer known as a Pantechnicon, reportedly towed by Scammell Wreckers for the majority, with some references stating its towing vehicle was a MKIII Leyland Hippo.

Red Beard was reportedly moved on the Hippo's cargo area, placed in stillages. Morris J2 vans carrying additional personnel and the convoy commander, as well as specialist Austin LD Convoys modified as emergency vehicles, accompanied the Pantechnicons, supported by RAF Police motorcyclists riding Triumph TRW 500s. For safety reasons, the fissile cores and main bomb sections never travelled together.

Post Military Use

The current owner, Keith Eldred, along with his wife Margot, bought the site from the RAF in 1966 with a plan to grow mushrooms in the vast DD buildings. In these, just three years before, the key parts of the UK's nuclear deterrent sat neatly on their bomb trolleys waiting to be called forward to mount a strike against the Soviet Union. The potential of a deadly mushroom cloud was replaced by a harmless cloud of mushroom spores....

The Eldreds surveying their purchase in 1966.
© Keith Eldred

Mushroom growing was dealt a crippling blow when an airborne virus decimated production. Not one to be down and out, Mr Eldred decided to create what is now known as the Gorse Industrial Estate. This thriving hub of 21 local businesses, which range from solicitors through to metal fabricators, enjoy good military-style security features, albeit now unmanned. Among the somewhat intimidating robust concrete buildings and blast traverses, a pleasant work environment comes through as the site is also a mini nature reserve where wildlife flourishes.

Preservation

Top Site is remarkably intact considering its use over the past 65 years. Mr Eldred has suffered two major losses to buildings in that time, both caused by fire. The first was in the late 1980s when one of the large DD buildings, let out to a plastics firm, caught alight. A local fireman I had a chance meeting with remembered how impossible it was to put the fire out due to there only being one entrance and the concrete structure behaving like an oven. Fortunately, the earth traverses protected the other site elements from damage.

The second fire took hold in the former Seco (prefabricated plywood-based building system) guardroom building around the turn of the century. The fire was believed to have been started by a glass object concentrating sunlight onto paper positioned on the windowsill. Being of a mostly wooden construction, the building was severely damaged and had to be demolished. It has since been rebuilt to match a neighbouring building.

A few of the smaller site features have been lost as a result of theft or sale. A good example of the former is when searchlights from atop the watch towers were stolen in the 1970s and have so far proved impossible to replace. With regards to site sales, times were hard when the Eldreds purchased the site as there were large outgoings and little revenue. It is easy for us now to criticise the selling off of in-situ equipment such as the large metal sliding gates and turnstiles, or the metal and cabling from inside the fissile storage buildings; however, if this had not have happened the chances are that the site would have not remained in Mr Eldred's ownership which could have resulted in its total demolition and permanent loss.

The fragility of the Seco huts was always a concern to the owner due to the previously detailed wooden construction. As a result, he covered them all with profile metal sheeting, increasing their life expectancy significantly. The dog kennels have given way to a new building and a couple more new structures have sprung up, including a large one that replaced the destroyed Seco guardroom building. They have been styled in keeping with the site and do not cause distraction.

English Heritage Involvement

In 1998, Mr Eldred was approached by the Royal Commission on the Historical Monuments of England (RCHME) who surveyed Top Site. As a result English Heritage subsequently listed certain buildings due to a mixture of their history, rarity and/or grouping. Both the Seco-constructed mess building and an administration building were given Grade II listing. The two large DD buildings and the CD maintenance building were all awarded Grade II* listing, a good indicator of how important this site is to the heritage of the Cold War.

Mr Eldred and English Heritage then funded a Conservation Management Plan in 2008. This kick-started various phases of work which have either been completed, are in progress or are planned. The costs of these phases of work have been shared between English Heritage (80 percent) and Mr Eldred (20 percent), amounting to approximately £250,000 so far and covering three phases, with a fourth planned. English Heritage is only financially supporting Mr Eldred on structures that he does not receive a rental income from.

Phase 1. The first phase ran from 2009–2011. It saw the restoration of the nearest watch tower to the main gate. Rather than outsourcing the work, Mr Eldred was able to make use of the extensive amount of skilled tenants renting his buildings, who were able to refurbish the metal and undertake the extremely complex woodwork of the

towers at very reasonable cost and to a very high standard. The tower reportedly had in the region of one thousand bespoke pieces in it, all meticulously restored into a state that will hopefully stand the test of time, standing as an iconic military symbol amongst rural Suffolk.

Watch tower under renovation in 2013.
© Kev Gregory

Phase 1 also saw the addressing of a major cracking and deterioration issue affecting the inner concrete wall pillars around the danger area. At first the solution offered was to sleeve the concrete pillars at a fairly steep financial cost, with an even higher aesthetic price to pay.

One of Mr Eldred's tenants came up with a cheaper and less distracting solution, which saw the construction of a U-shaped bracket to prevent any further pillar damage as well as to spread the weight of the concrete panels. This has been adopted around the site. In addition, six of the fissile storage buildings were selected for refurbishment with the intention to display them in the known colour schemes they wore in the seven years they were in use. These colours were identified from paint-scrape analysis.

Phase 2. The second phase began in 2011 and is now complete. It saw work begin on two further watch towers and the replacement of broken concrete slats from the inner wall. In a deviation from its original purpose the inner perimeter won't be fully enclosed in order to provide emergency access and egress options.

Phase 3. Overlapping phase two, the third phase began in 2012 and is set to run until 2014 and is dealing with the fourth watch tower. The fifth tower was set to be left to show the effect of nature on it; however, there is a fear that nature has already been too overzealous and that it may need some work to ensure its structural integrity and safety!

Phase 4. It is hoped that a fourth phase can also be initiated. There are many things that Mr Eldred would like to see done inside and outside of English Heritage funding. These include, but are not limited to, the following:

a. The renovation of the railings and footpaths to the fissile storage buildings, as well as refitting some of them with their equipment such as safes, tables and lights
b. The renovation of the RAF Police inner picket-post where passes were checked and flammables were surrendered before entry to the danger area
c. Work on the generator blast walls near to the main entrance
d. The southwestern watch tower made safe
e. The revamping of the 1950s lamp posts which are falling into disrepair
f. The acquisition of a *Blue Danube* and *Red Beard* bomb mock-up
g. The treatment of the concrete gantries outside the DD buildings which are suffering from concrete cancer.

Other Grants

Thirty years ago, Suffolk County Council provided Mr Eldred with a grant to grow a mixed hedge around the site perimeter along with providing some sixty bird boxes, utilised for ringing around 150 birds each year.

English Heritage also provided a maintenance grant to deal with extensive tree clearing. It is quite remarkable how a site that some 55 years ago was deliberately made tree-less could become a mini forest so quickly. The majority of the trees within the sterile area and inner areas have now been removed to give a sense of how the site would have looked when operational; however, some have remained for the aforementioned nature reasons.

In recognition of his long-standing commitment to the preservation of the site, Mr Eldred was awarded a Certificate of Commendation in the 2012 English Heritage Angel Awards.

Visitor Centre and the Future

The University of East Anglia (UEA) have utilised RAF Barnham's Top Site as part of their 'Cold War Anglia' project, along with other sites in this region. In conjunction with English Heritage and the owner, they have been putting together reading and interactive material for a visitor centre, aimed at providing an insight into what the site did and its significance to the Cold War story in the area. It is work in progress, but so far Mr Eldred has provided and decorated a room on the side of the ED building to house this centre. In the short term visits to the site will be on an appointment-only basis, with the long-term aspiration to be able to open more frequently to the walk-in public.

Along with the further grants and plans to preserve the site, Mr and Mrs Eldred will eventually be handing the site over to their sons Richard and Mark, who fortunately are as passionate about it as their parents. This love of the site stems out of growing up with it as an integral part of their lives, acting as a giant adventure playground when

they were young. Today, Richard's children and their dog still enjoy the site in that way.

With the level of official protection provided by English Heritage and the strong family will to preserve it, the heritage of Top Site is not only going to be preserved but enhanced as the years go by. It is a fitting status for a unique monument to a time in our recent past where some very serious options were sought to safeguard our way of life.

If this has interested you, please take a look at my dedicated picture-based website at www.rafbarnham-nss.weebly.com, where you will also find contact details. The website will continue to grow as more information comes to light.

Photos Sam Tolley unless stated

Massive cannabis factory found in the former RGHQ at Drakelow

A large-scale cannabis farm has been discovered in the rambling network of WWII tunnels at Drakelow near Kidderminster.

The site was used to manufacture machine parts during the Second World War and in about 1958 part of the site was developed by the Home Office as a Regional Seat of Government (RSG9). Under later Home Defence schemes Drakelow was designated a Sub-Regional Control (SRC), Sub-Regional Headquarters (SRHQ) and finally Regional Government Headquarters (RGHQ). The site was greatly modernised in the early 1980s.

The main entrance to the RGHQ. Photo by Nick Catford

Officers seized more than 400 cannabis plants while executing a search warrant at around 9am on 27 November. The street value of the drugs has been initially estimated at around £650,000. The warrant was obtained under the Misuse of Drugs Act and the operation involved around 30 police officers and staff from West Mercia Police and Warwickshire Police, including dog handlers. Officers also found a network of hydroponic equipment including heating, lighting and ventilation fans. The plants were in various stages of growth and cultivation.

Earlier officers executed an associated search warrant in a dawn swoop on an address in Kidderminster where a 45-year-old man was arrested on suspicion of money-laundering and being concerned in the production and supply of controlled drugs. A quantity of cash was also seized at the property.

The food servery in the RSG. Photo by Nick Catford

North Worcestershire Superintendent Kevin Purcell said that officers had been briefed in advance on the historic nature of the site and that had been reflected in the way the operation had been carried out. The aim had been to cause as little disturbance as possible within the complex. The health and safety aspects of the operation had also presented significant challenges due to the sprawling nature of the tunnel system and the need to search over a wide area.

Supt Purcell said: "The operation has been mounted to tackle the illegal production and supply of controlled drugs which is linked to acquisitive crime such as theft, burglary and shoplifting. This can cause serious harm in our communities.

"While executing the warrant at Drakelow tunnels we discovered a large and sophisticated cannabis growing operation and although the plants will need to be tested it would appear that this seizure has prevented a large quantity of illegal drugs ending up on the streets. That in itself is a very positive outcome."

In September this year Warwickshire Police and West Mercia Police launched a new three-year drug strategy designed to make life a misery for dealers while working with partners to steer addicts towards treatment and youngsters away from taking them.

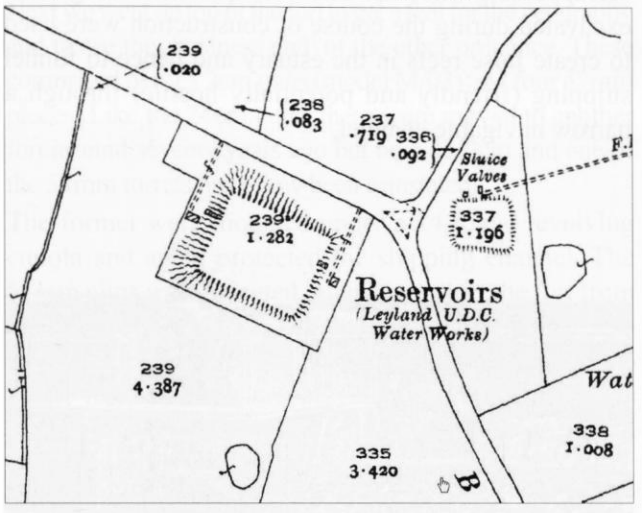
Source: *The Kidderminster Shuttle*, 27 November 2013.

Clayton-le-Woods Service Reservoir

Ken Geddes

The underground reservoir at Clayton-le-Woods, near Chorley, Lancashire, was built in 1883 as part of the drive to improve living standards after the industrial revolution had transformed this part of Lancashire.

Provision of clean water was necessary to reduce the outbreaks of cholera, but also became a symbol of civic pride. The reservoir has not been used for seventy years, but was fully maintained as a back-up until the mid-1980s. United Utilities recently obtained planning permission for its demolition with the land to be reused for urban housing. Subsequently the site was purchased from United Utilities by Kingswood Homes.



1941 1:2,500 Ordnance Survey map

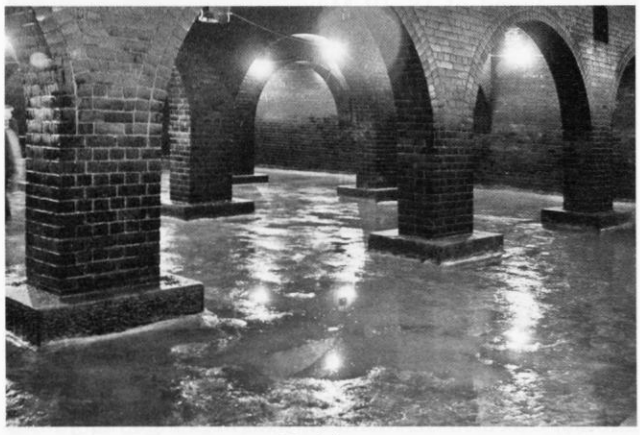
Local history

The origins of the reservoir can be traced back to 1863 when the Leyland Local Board was set up to consider works which would improve the town. They recommended provision of clean water – and sewers to deal with the waste. The estimated cost in 1880 for these facilities was £5,000, but like many such projects, this had inflated by May 1882 to a very precise £6,334 8s 5d – and in August of that year to no less than £9,000! The design and engineering management of the project was by Mr William Wrennall, Civil Engineer, of Liverpool.

The water supply was to be pumped from a well and a trial bore for this passed through beds of marl, shale and limestone before reaching solid sandstone; its final depth being 130ft 6in. Tests showed that water was abundant and suitable for domestic use. A production well was sunk of 8ft diameter and to a depth of 70ft by Ebenezer Timmins of Runcorn, who had also sunk the trial bore. The two bores were eventually connected as a part of the work.

The Service Reservoir, designed to hold 300,000 gallons of water, was built by William Crook of Chorley, who also built the Engine and Pumping Houses. Reservoir construction was under way by the following year despite chaos in the town from the installation of pipes and consequential compensation claims.

Work was well advanced by August 1883 when the foundation stone of the Pumping Station itself was laid by Mr Henry Dobson, Chairman of the Leyland Local Board. The reservoir was built of stone rubble in hydraulic mortar,



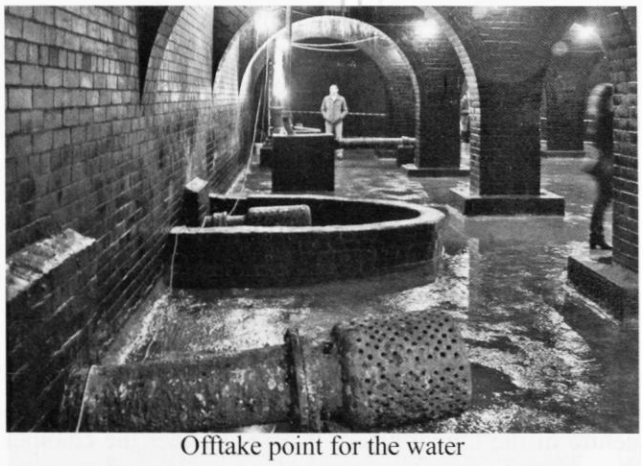
Vaulting

backed with clay puddle and faced internally with brick lining in concrete. The arches were constructed from brick with the floor of concrete.

Water was obtained from the well under the pumping station in Preston Road, Chorley and transferred up to the reservoir using a steam pump. The water flowed back by gravity through an 8-inch main to Leyland, two and a half miles west, the reservoir being 180ft above Leyland village and 250ft above the lowest part of the district.

Steam yields to electricity

The mains were laid by Walmsley & Co. of Preston using pipes supplied by the Staveley Coal and Iron Company of Staveley, near Chesterfield. The steam pump was eventually replaced by a submersible electric pump.



Offtake point for the water

By the late 1930s the original reservoir was unable to provide sufficient water for the town and in 1940 a new and larger reinforced concrete structure was built, the older one being retained as a back-up. By this time a connection was made to the Thirlmere Aqueduct.

The vaulted brickwork structure of the reservoir was unique in the northwest of England and two unsuccessful attempts to apply for listing were made by the Chorley Historical and Archaeological Society.

References:

"*Commemorative History of Clayton le Woods Service Reservoir*" published by Kingswood Homes who cite the *Preston Guardian* dated 4 August 1883.

"History of Leyland and District" by David Hunt

Plus information from members of Chorley Historical and Archaeological Society.

A busy weekend in Sweden – Sub Brit in Gothenburg

Martin Dixon

The weekend of 18–19 May, 2013 was a busy one in Sweden. On Saturday, Gothenburg hosted the world's largest half-marathon with over 58,000 runners. The same evening, Malmo hosted the Eurovision Song Contest, and on Sunday Sweden won the World Ice Hockey Championships in Stockholm. For anyone with an interest in the underground, however, it was no contest; the most compelling event was the Sub Brit weekend trip in and around Gothenburg.

The 34 participants arrived via air, land and sea. We were met and welcomed by Lars Hansson, our hard-working weekend organiser. We also had Pingo Olofsson, another Swedish SB member, with us; Pingo had joined for the trip and was able to help with guidance and translation. The first challenge was to pronounce our destination correctly. Spelt as *Göteborg* in Swedish, the pronunciation is similar to 'Yur-tay-BORY'. Overnight temperatures in the UK were close to freezing but by mid-afternoon Friday the mercury in Gothenburg approached 30 degrees (Celsius!).

However our destination for Friday evening and the following three nights was Kungälv – a small town about 20 kms north of Gothenburg. Here we had excellent accommodation in what was once a Norwegian town. As the various groups arrived, an ever-increasing circle formed on the terrace overlooking the river and local beer sales soared. As usual there was a good mix of long-term members along with those venturing on their first organised trip. We had ten major underground sites ahead of us – half of them never visited before by Sub Brit.

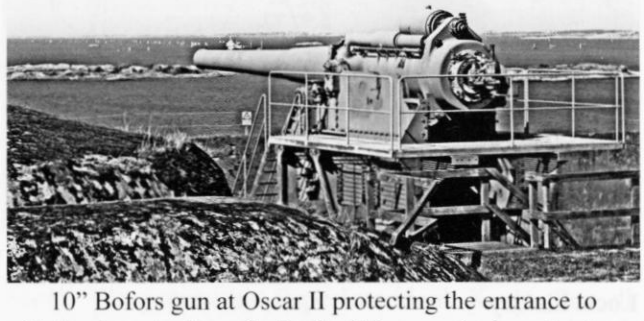
The hotel breakfast the following morning was an extensive buffet with a selection of traditional Swedish dishes alongside the more usual fare. The tables even had lighted candles – a touch of luxury well above our often budget hotels. A swift headcount revealed that everyone had made it so we embarked on our coach for the day's visits.

We soon passed beneath the old harbour (Stora Hamnkanalen) in a recent road tunnel. Intriguingly, the centre of the tunnel where it passed under the channel was marked with atmospheric blue light to symbolise the water. Apparently it was partly done to keep the attention of drivers and partly as a design feature. Either way, it was very attractive.

Oscar II Fortress

A short distance beyond the current harbour of Gothenburg we arrived at our first site – the Oscar II fortress. Built between 1903 and 1907, the fort was named after the then king of Sweden (and until 1905 also king of Norway). When built, Oscar II was well ahead of its time. It had hot-air heating, electricity and inside toilets when many of the local population had none. At the time of construction there were no reliable roads from nearby Gothenburg and so a dock and narrow-gauge railway were built in order for the building materials and armaments to be shipped in.

The location was chosen to provide a commanding position over the sea approaches to Gothenburg. The design used the massive granite bedrock to provide superb protection for the garrison, services and armaments, surrounded by a huge dry moat with daunting counterscapes and caponiers. The main firepower was located in armour-plated turrets or within the moat on 'disappearing' mounts. The vast quantities of granite excavated during the course of construction were used to create false reefs in the estuary and hence to funnel shipping (friendly and potentially hostile) through a narrow navigable channel.



10" Bofors gun at Oscar II protecting the entrance to Gothenburg harbour. Sadly the 'disappearing' mechanism has now itself disappeared. Photo Lars Hansson

The first site in Europe to use the same design was at Vaberget close to Karlsborg at lake Vättern, completed in 1902. Oscar II and a sister fort at Boden in the north, facing Finland, were the second two examples. What makes Oscar II especially notable is that, unlike most other contemporary forts, it has kept its original design and didn't undergo remodelling during World War II or the Cold War. The armaments are a forerunner of the Maginot line design and the site as a whole has some similarity to Western Heights at Dover.

The site is now looked after by a local group and Martin and Camilla were kept busy showing us round for the next four hours or so. The volunteer group that supports the fortress is run along military lines and anyone wandering off was threatened with a court martial!

We started with the moat – within it were two immense 24cm (c.10 inch) breech-loading guns, built by Bofors in 1904. These were moved to another fort further down the estuary in the 1940s but returned to Oscar II after decommissioning. Sadly they had lost their 'disappearing' carriage in the course of the 1930s move but are nevertheless very impressive. The barrels alone weigh around 24 tonnes and the effort involved in their original installation must have been immense.

Pair of 10" breech-loading Bofors guns dating from 1904 within the Oscar II fortress. Photo Nick Catford

Next we went on top of the fort to get a feel for the geography and to see the 'business end' of the other ordnance. These comprised two 15.2cm guns (model M/03) and four 57mm pieces. Like the 24cm guns, these were moved to another fort around seventy years ago but both 15.2cm and one of the 57mm turrets have now been reinstated.

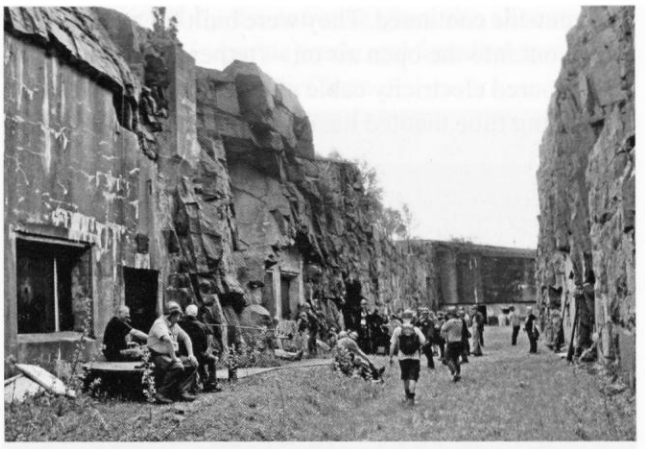
The former were mounted under a 24-tonne revolving cupola and again protected the shipping channel. The 57mm guns were oriented inland to protect the fort from landward attack. Up to 100,000 land forces would also have protected the fort from a rear attack. Also on the top of the fort were two low-profile command posts – one dating from WWI and the second (in rather inelegant concrete) from WWII.

Going Underground

Now it was time to enter the mountain itself. We were able to view one of the 15.2cm guns and the extensive support infrastructure was fascinating. The whole was constructed in Art Nouveau style and all corridors were white painted, with living space wood-panelled and decorated. Surprisingly, the NCOs' Mess was more extravagant than the Officers' one.

Circulation space in the rock-cut underground of Oscar II. The fine tiled floor contrasts with the raw granite walls. Photo Lars Hansson

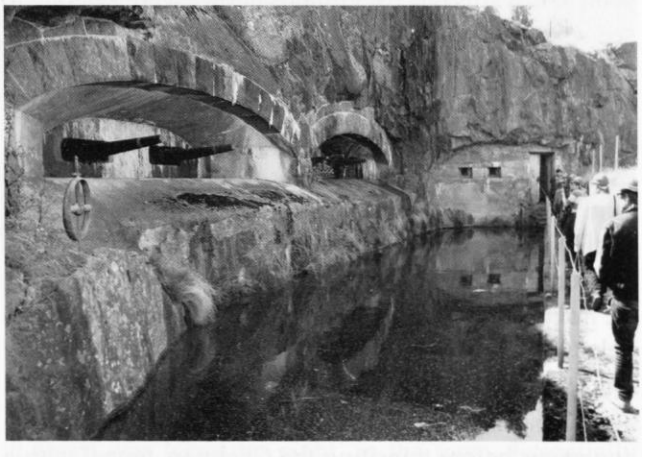
The explanation was that Officers moved about frequently whereas NCOs spent all their professional career in one location and wanted a 'home from home'. As well as the living accommodation we were able to visit magazines, the kitchen, generator and the WWI fire-control centre.



Dry moat surrounding the core of Oscar II

Having exhausted the inside, we took a last turn around the moat and then descended to sea level to view the Gotiska satellite site. This was equipped with a further four 57mm (M/99) pieces, this time ranged out to sea. Like the main fort, the battery was completed in 1902 and finally closed in 1986 (the main fort succumbed much earlier, in 1955). The battery is (almost) in firing condition but the last ceremonial salute caused a deal of smoke and nausea as all four guns were fired simultaneously! At the beginning, the gun crew all lived within the complex but in its latter years the battery was garrisoned by troops in surface accommodation.

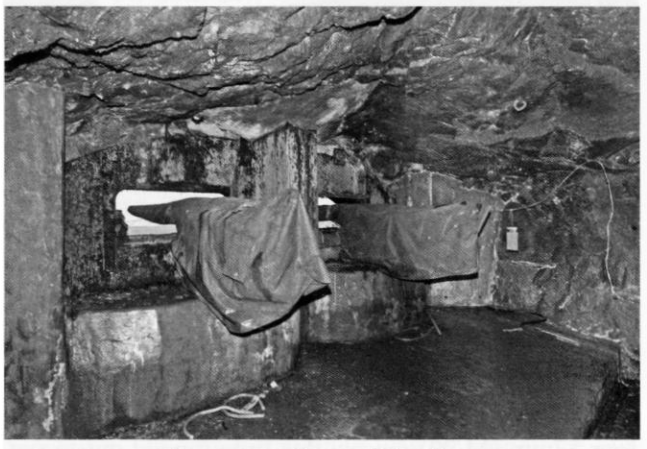
Walking round the front of the guns led us to the banks of the River Göta, over whose channels the guns are ranged. We broke for lunch watching car ferries from Denmark and Germany negotiating the river. As a change from the usual sandwiches, the hotel had prepared individual salads which went down a treat. After lunch, a few outside features were explored including the fire-command post which connected via a speaking tube and telephone to the guns below. There were also several slit trenches for surface troops and a metre-gauge railway that intriguingly led into the fort through a now-blocked door.



The 'business end' of the four 57mm pieces at Gotiska battery

Within the complex, we were able to identify the Officers' quarters, kitchen and toilets. Heating was provided by the Swedish equivalent of the 'Gurney' stove that heats many British cathedrals and churches. At the rear of the fort, through a hundred-metre rock-cut passage, the rails seen

from outside continued. They were built for a searchlight to roll out into the open air on – 'tethered' to the fort by an armoured electricity cable still in place. Here too was a speaking tube that led back to the centre of the fort.



Protected breeches of two of the 57mm guns at the Gotiska Battery. Photo Lars Hansson

Tram replacement service

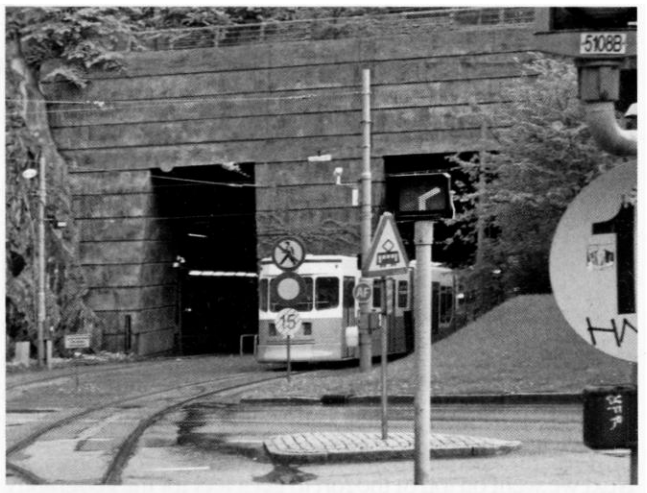
This superb site was a benchmark that the rest of the weekend lived up to and eventually it was time to move on. We strolled down to the nearest tram stop at Långedrag – about fifteen minutes away. Gothenburg has the largest tram network in Sweden with twelve lines, over 160 kilometres of track and around 200 trams in service.

The tram system was started in 1879 by an English company with a horse-drawn service. The system was bought by the city in 1900 and hugely extended over the following forty years. When Sweden converted to driving on the right in 1967, the system required extensive changes to stock, signalling and tracks.

In the late 1960s, there were plans to convert the tram system to an underground network and extensions were built with tunnelled sections. This idea was abandoned soon afterwards on cost grounds but we were heading to see what remained of the plan. Our journey was full of off-route running as most routes had diversions in place to avoid the massive half-marathon taking place.

Starting on route 11, the first challenge was to herd everyone onto the same tram – made difficult by those who had nipped off for ice cream or to sunbathe. Eventually we all mustered and the next challenge was to deduct 34 journeys from the single RFID travel card we had purchased for economy (RFID replaced mag strip tickets around 2010).

We changed trams (off route) at Marklandsgaten and here changed to line 8. En route we experienced a sudden downpour before transiting the Chalmers tunnel with a length of 1,050 metres which opened in 2002. More fun was soon to be had as the on-board destination display of 'Angered' changed to 'Bellevue' (perhaps it should have been 'Confused').



Tram entering Chalmers Tunnel in central Gothenburg. Photo Martin Dixon

Bellevue is on routes 6, 7 and 11 but because of late running the number 8 we were on was diverting and terminating here – presumably to reverse. Luckily we worked out what was happening and disembarked at Gamlestadstorget and with a swift platform change eventually regained the right route on a number 9!

Just before Hjällbo station the tram switched to left-hand running which was a surprise. It turns out that the last four stations were built with island platforms to save money and the trams therefore have to left-hand run as they only have doors on the right-hand side. Mystery solved, we then entered another tunnel and eventually arrived at the underground Hammarkullen station. This was built in 1972 and refurbished in 2002 and is attractively finished in unlined granite.

Underground tram station at Hammarkullen. Unusual left-hand running to access the island platform

After a short delay while the photographers went to work, we ascended the longest escalator (*rulltrappa*) in Gothenburg of 58 metres. Like the Stockholm Metro, the shaft also features a parallel inclined lift for the disabled and Sub Brit members!

Chaffinch

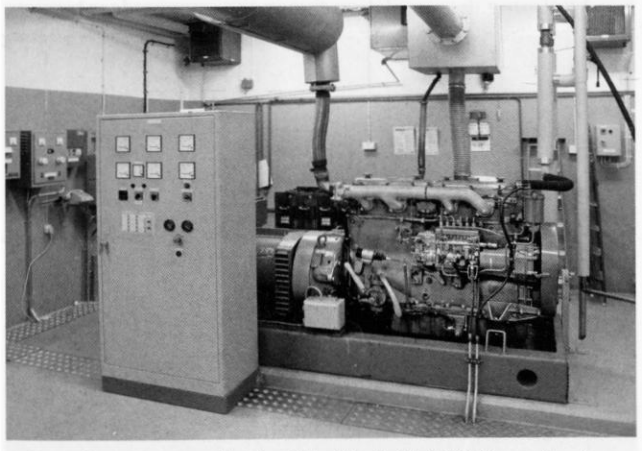
After a short coach ride we arrived at our final site of the day – the civil defence centre that covered the north of Gothenburg, code-named *Chaffinch*. After an epic

and impressive feat of reversing (our coach driver used to drive articulated lorries) we were met by Kenneth, our host for this and two other sites over the weekend. Kenneth works for the local fire brigade and with his helpers was a knowledgeable and enthusiastic guide.

Chaffinch was originally built as an ammunition store for the nearby Air Force base at Säve in the 1960s. Between 1965–66 it was converted into its civil defence role. After a short briefing in the cafeteria we were given free rein of the complex.

Dining area within the *Chaffinch* Civil Defence bunker

The site is in a remarkable state of preservation. Along a long access tunnel, a substantial cavern has been excavated and within this, protected by blast doors, lies a robust concrete inner core building. This has decontamination facilities and accommodation spread over two storeys. Downstairs is essentially domestic space – dormitories, kitchen, restrooms and cafeteria. Upstairs is a large command centre with air handling, emergency generator, radio room etc. The whole is decorated in a predominantly orange finish but the feel is more of a contemporary IT suite or private hospital. After a lightning strike in 1990 the complex was refurbished and finally closed in 1996.

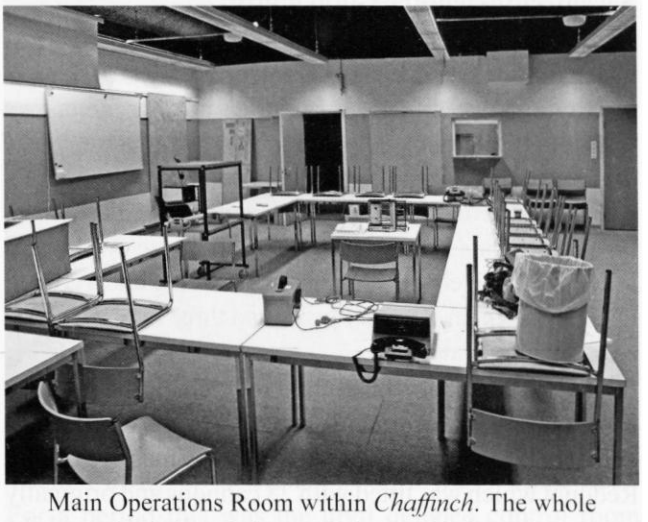


Standby generator in the *Chaffinch* Civil Defence bunker

It looks, however, as if it closed yesterday, and the equipment is all operational and in pristine condition. The dormitories have bedding, lockers and small nets for personal possessions all in place and are quite spotless. A display board by the entrance gives the allocation of each bunk in the (separate) male and female dormitories. No hot bedding or mischief here...

Chaffinch entrance hall and stairway. The machinery at the end of the hall is a dehumidifier. Photo Lars Hansson

Upstairs, handbooks, maps and manuals are all in place as is the communications kit. We resisted the temptation of seeing if the siren activation panel was still in working order! A large Faraday cage was present where duplicate sets of all electronic equipment would have been stored in the event of the primary set-up being compromised by an Electromagnetic Pulse (EMP). Emergency exits on both levels led around the inner building from where secondary exits and the radio shaft could be accessed. All external entrances were heated to minimise humidity and I think everyone agreed that the overall feel of the bunker was such that it would have been a very pleasant work environment.



Main Operations Room within *Chaffinch*. The whole complex is in pristine condition and fully equipped

Cruising Night

Two surprises awaited us when we arrived back in nearby Kungälv. The first was that Saturday night (this Saturday at least) was 'cruising night' in the town. Essentially several hundred vintage American cars spent the evening driving around the small town. Many of these were open-topped and many more were blasting out music at high volume.

There was a smaller number of larger and military

vehicles including an amphibious Russian truck and an American police vehicle – presumably legally allowed as the sign said 'Police' rather than 'Polis'! Passengers were carried in all possible locations, including sitting on tailgates and even in the boot. The real police were in attendance and taking a low-key approach to what proved to be a very good-natured and entertaining parade.

Our second surprise was that we had our evening meal in a semi-underground private building just across from the main hotel building. This had been built as an old food store in 1812 and its sunken location would have helped preserve the ice that was used to keep the foodstuffs cold. We had a fine meal of local lamb before continuing our research into the high price of local alcoholic drinks.

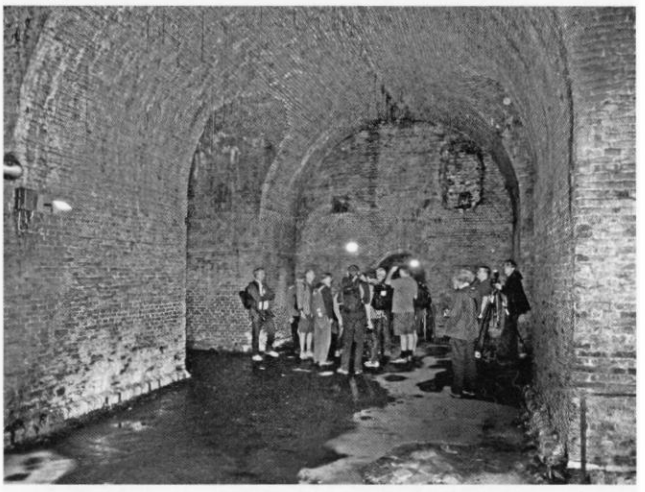
Martin Dixon presents Lars with a thank-you gift in the 1812 underground food-store where we dined on Saturday evening

Seventeenth-century Gothenburg

Sunday dawned with sore heads and clear skies. Our coach dropped us in central Gothenburg where we were met by our two guides, Ewamarie and Margareta. We split into two groups to take a look at what remained of the city's seventeenth- and eighteenth-century outline. Although the defences can still be deduced from the layout of today's streets, the city walls were dismantled in 1806. However a few remnants, including underground ones, still remain. The city walls had three land gates and two from the water.

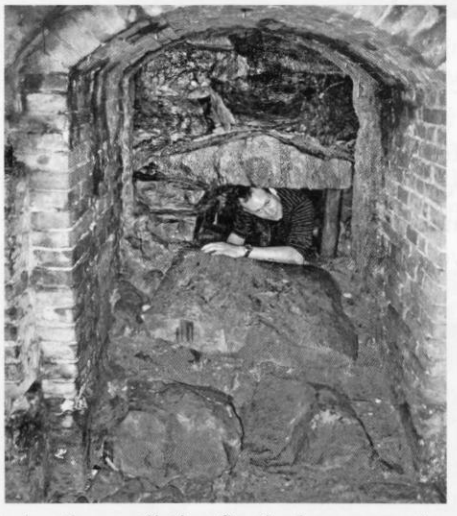
Firstly we stood atop one of the few remaining bastions of what was the fourth and final stage of the city defences. From it we could see the nearby massive Crown Redoubt which was fitted with 23 cannons and originally connected to the bastions by a covered walkway. Like its twin, Lion Redoubt, it was built to protect the city against attack by the Danes from the south. Built from huge granite blocks, the defences would have been the only stone structures as houses were all wooden-built even after the disastrous fire of 1804.

Next we descended into what was originally an eighteenth-century gunpowder store. As such it was lined with brickwork, exquisitely executed, to prevent the sparking that a granite finish might cause. It appears the structure suffered from damp and so was converted to a prison and housed 114 Russian prisoners of war for two years.

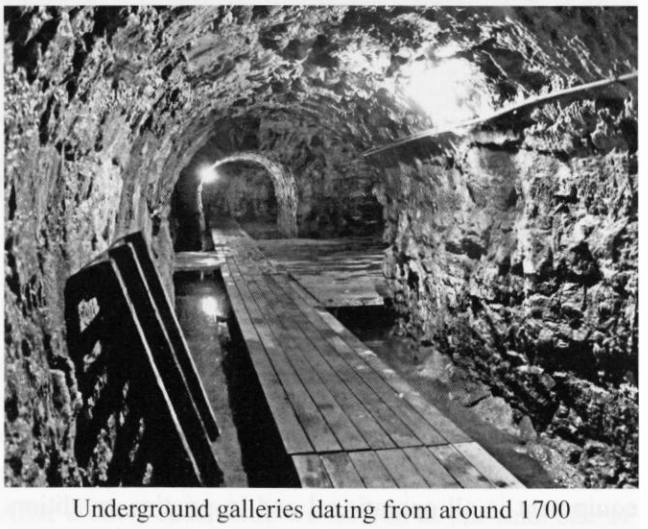


The fine brickwork of the 18th century gunpowder store, later converted to a prison

Adjacent to the west or Charles Gate, the site was used as an air-raid shelter in World War II. One youngster who lost a football through a vent into the shelter in the 1950s was amazed to have it returned sixty years later (still inflated) when archaeologists found it.



Exploring the ventilation flue in the gunpowder store



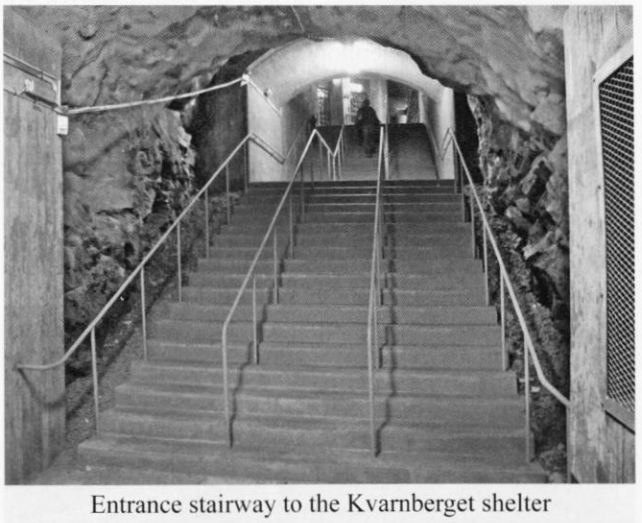
Underground galleries dating from around 1700 beneath the city hospital in Gothenburg

Next we entered an underground car park and were able

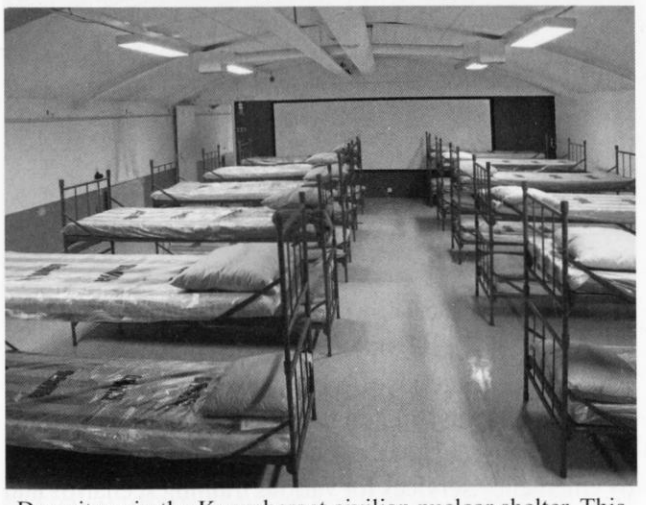
to see the preserved remains of an orillon (an ear-shaped defensive projection from a bastion). Finally we entered some underground galleries that have fortuitously been preserved in front of what was the city hospital. Dating from around 1700, the galleries radiate out from a central point and terminate in casemates. Part of one of the galleries has been used at some stage as a drainage channel so perhaps when the hospital was built the galleries were used thus and preserved. Tour over, our two groups reunited and continued on foot to our next site.

Kvarnberget Skyddsrum

As we walked to a lookout point above the old harbour, those with an eye for these things could see the trademark giveaway of the Swedish Cold War shelters. This is a small orange sign (maybe three inches square) with a blue triangle within and the word *SKYDDSRUM* or bomb shelter. The one we were about to visit was massive and would have accommodated around 5,000 people. Its name is Kvarnberget or Mill mountain – named after a windmill which once graced its upper slopes. Entrance was through a secure gate and followed by a descent down a stairway. This was followed by a curving passage to help deflect bomb blast.

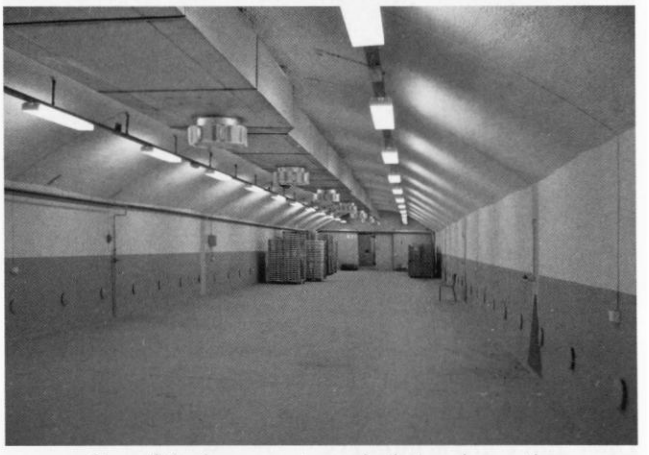


Entrance stairway to the Kvarnberget shelter



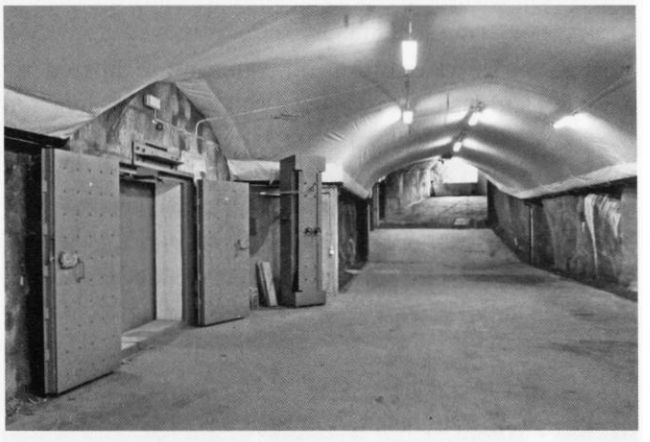
Dormitory in the Kvarnberget civilian nuclear shelter. This is just a small portion of one of the 60 metre long shelters

In the shelter itself, the entrance area has generator and air-handling machinery and a small control booth with public address and radio facilities. Four immense shelters around 60 metres long are intersected by cross passages at top and bottom. One of the shelters is currently used for storage by the city but the other three were accessible. One has scores of stacked bunks and all have basic water points spread along their long walls. Refurbished in 1993, the site is on 48-hour readiness even today.



One of the immense tunnels that make up the Kvarnberget shelter. Photo Martin Dixon

The bottom cross passage forms the emergency exit and is much larger than the other. Indeed it is large enough for a truck to drive along for the delivery of supplies. The cross passage itself is unprotected but each of the four large shelters terminates in a massive set of blast doors. A few other rooms exist – probably for food and first aid, but there is surprisingly little catering or support space.

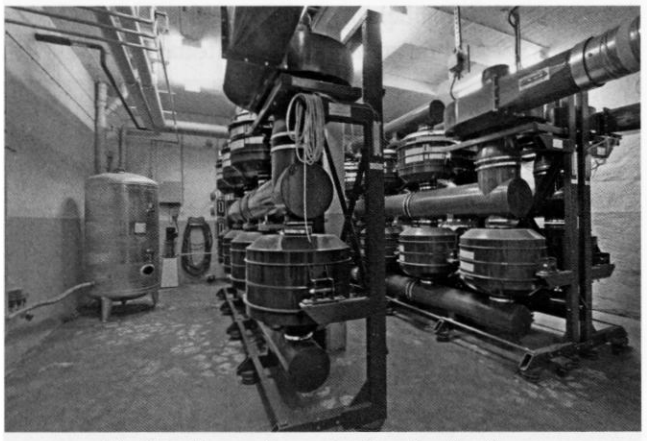


Rear entrance passage and immense blast doors at the Kvarnberget civilian nuclear shelter

Tucked away up a flight of stairs was a final treat. For a period this was the civil defence control room for Gothenburg, code-named 'Sunflower' (*Solros* in Swedish). This set of rooms is on a single level and includes a single blast-protected emergency exit. This exit also has decontamination facilities and like all drains within the complex, the drain gully can be closed off to prevent over-pressure outside the shelter causing foul water to flow backwards and contaminate the building

Within *Sunflower* was a central control room – still equipped with maps of Gothenburg and, in particular, other shelters. When the command centre was opened, Gothenburg was

a much smaller city and it became clear that to have a civil defence centre in the middle of the area that might itself be damaged would prevent free flow of vehicles and staff. Consequently *Sunflow*er was replaced by a much larger centre to the east of the city which we were to visit next.

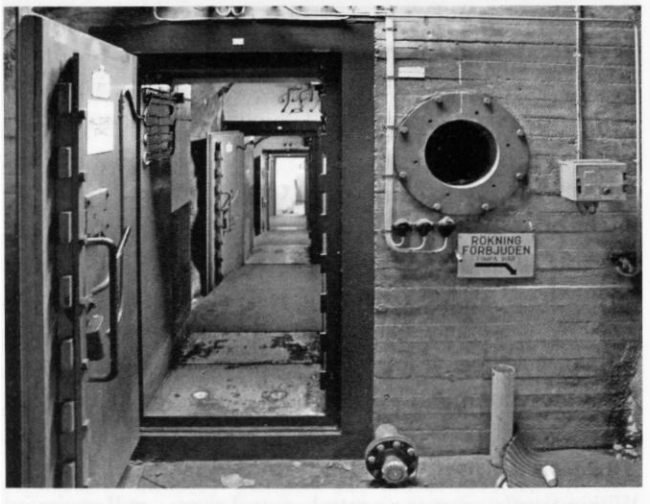


Air filtration units protecting the *Sunflower* Civil Defence site. Photo Lars Hansson

Otter and *Curlew* bunkers

Aboard our coach once more, we drove out to the east of the city. Stopping at an anonymous gate leading to a wooded area, we found ourselves at *Otter* – the main civil defence site for Gothenburg, which replaced the previously visited *Sunflower*. Built in 1951, the site took around three years to complete and would have housed around one hundred people. In the early days the civilian site was co-located with *Curlew* – an air-defence control centre. However, it was concluded that this co-location went against the Geneva Convention and so the military site was moved elsewhere.

Before our next exploration, once more hosted by Kenneth and his colleagues, we had a leisurely lunch in the forest around, some members catching up on sleep missed the previous night. Naps over, we assembled in the canteen of this enormous bunker. Kenneth had worked hard to get special permission for us to visit the site but as the emergency exit involved a vertical ladder, we had to visit in small groups.



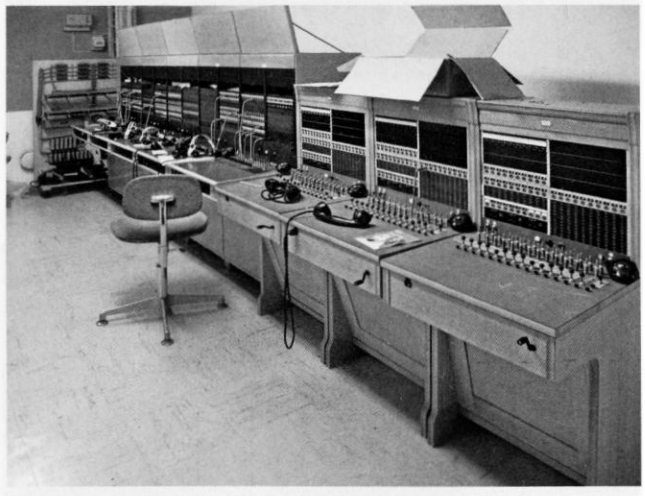
Airlock and overpressure valves at the entrance to *Curlew*. Note the heating elements to reduce humidity and prevent condensation at the entrance

Lars set up a small bookshop and those waiting to tour were able to view the large kitchen, linked to the canteen by a server area. Although the bunker was nominally resourced by 100 staff, the kitchens could have catered for at least five times that number. There were walk-in cold rooms and refrigerators and every manner of large industrial catering plant from large vats to bacon slicers.

The canteen was on the ground floor of the four-storey bunker and the tour began with the dormitories which were adjacent to the kitchen area and other recreation rooms. The separate male and female bunks were stacked three-high in small rooms, with around 100 beds in total. Colours were overall in muted pastels compared with the more vibrant orange of yesterday's *Chaffinch*. The electrical supply is still part of the network supplying a local village and as such we were unable to visit the standby generators.

Ascending to the first floor, we walked along an unusual feature of the bunker – a large curved corridor in contrast to the grid layout that usually exists. No one is sure why this layout exists – perhaps it somehow makes best use of the geology of the surrounding granite cavern. The first floor holds predominantly support services and telecommunication equipment.

We visited a large telephone MDF (Main Distribution Frame) and associated telephone exchange. Printers from the 1980s were housed in once common sound-deadening boxes. Like *Chaffinch* yesterday, a substantial Faraday cage was built to hold spares of all electronic kit. We passed the reused area where the air-defence command was once located. All the air-raid alarm controls are still in place, controlled by phone circuits to each siren.



Large manual switchboard in the *Curlew* Civil Defence bunker

One of the general offices was obviously used by meteorologists as a plotting board with isobars and fronts drawn on it dominated the space. Today the bunker is used by emergency services for various training scenarios and 'do not pass' tape was a reminder of a recent exercise.

The second floor was dominated by a massive single space – the main control room, perhaps 30 metres by

10. The size of the space was emphasised as much of the furniture had been removed. Here was the control panel for the situation lights which are spread around the whole bunker. These comprise a column of coloured and lettered lights which would have been set as follows:

F = Air Raid (Red light)

R = Radioactive fallout (Orange)

G = Gas attack (Green)

A = Full alert – all staff on duty (White)

B = Half staff on duty (also White)

Adjoining the main control room are other offices including a meeting room with an extensive collection of maps. Finally we climbed to the top floor, which is a much smaller radio annexe. Some of the radio equipment is still in use, for example it manages the call-out of local retained fire-fighters. Also on this level is a large water tank – surrounded by a bund to prevent inundation of the bunker if a breach to the main tank occurred.

Through the blast doors of the emergency exit on this level you could see the native granite cavern within which the bunker is constructed. At this point there is perhaps ten metres of granite cover and cables lead to the aerials which sit above. The emergency escape also exits vertically from this point.

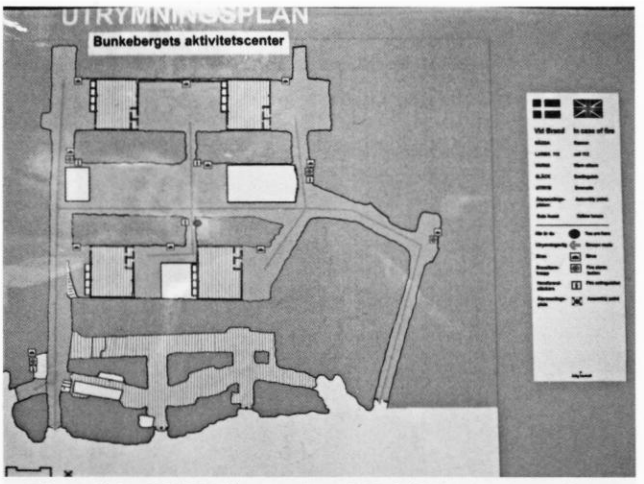
Ball bearings for skateboards

A short coach ride took us to our final sites of the day. Aktiebolaget Svenska Kullagerfabriken (which translates as the Swedish Ball Bearing Manufacturing Company) is universally known as SKF. Since it was founded in 1907 it has been a major supplier of ball bearings (*kullager*) to the military forces of Sweden and other countries.

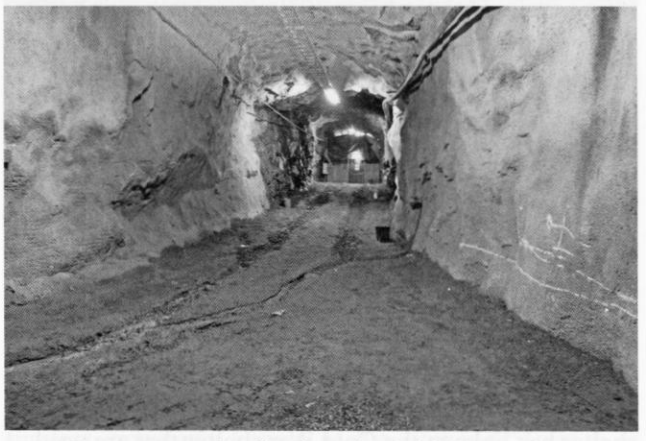
In World War II the components were so valuable that civilian pilots flew Mosquitos from England to Sweden to bring back ball bearings for the UK armaments programme. As a precaution, SKF built an underground factory to provide protected workshops. As Sweden remained neutral throughout the war the factory remained above ground and the mountain was instead used as an air-raid shelter (Berg 211) throughout the war.

Later, during the Cold War, it was realised that the WWII shelter would be vulnerable to nuclear attack and so a second (and larger) underground factory was built deeper within the mountain. In terms of size, the original WWII site covers around 800 square metres and the later Cold War replacement around 5,000 square metres. Lars had arranged for us to access both sites, which are now each being used for purposes that their original constructors would no doubt be mystified by.

We started with the later and larger shelter which is situated opposite the impressive headquarters building of SKF. Descending on a gradual slope about 50 metres, we entered a cross passage that was intersected by three main chambers, each measuring around 15 metres by 80 with a height of 10 metres. Since 1998 the shelter has been used as a skateboard park known as *Bunkeberget* (Bowl



Plan of the WWII (bottom) and Cold War (top) portions of the underground SKF ball-bearing factory. The tunnel on the right led to the above-ground parent factory. Photo Nick Catford



Descent ramp leading into the Cold War section of the SKF Factory. Photo Nick Catford

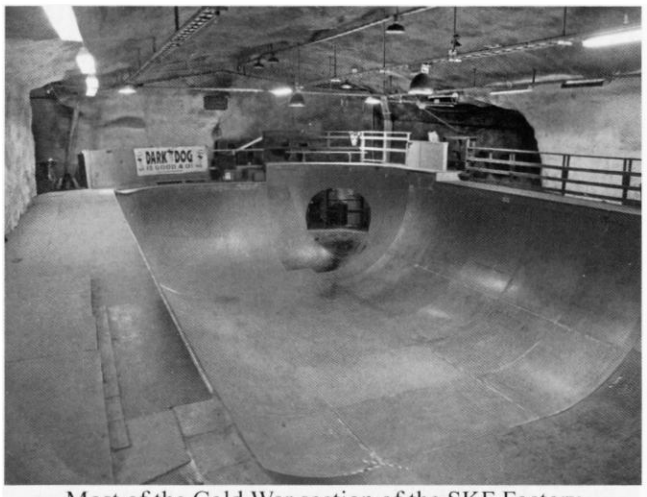
mountain) and these chambers are now chock-a-block with ramps, half-pipes, bowls, rails, ramps and stairs from the modest to the downright terrifying.

Each of the major structures has a name that wouldn't look out of place on a cocktail list including Dark Dog, Hawaii and Blue Lagoon. As it was summer, the city's youth were using outdoor parks but the site must be a godsend to those who want to practise their sport over the long Nordic winters. Today's skateboards rely on ball bearings so there is at least a tangential relationship to the original purpose.

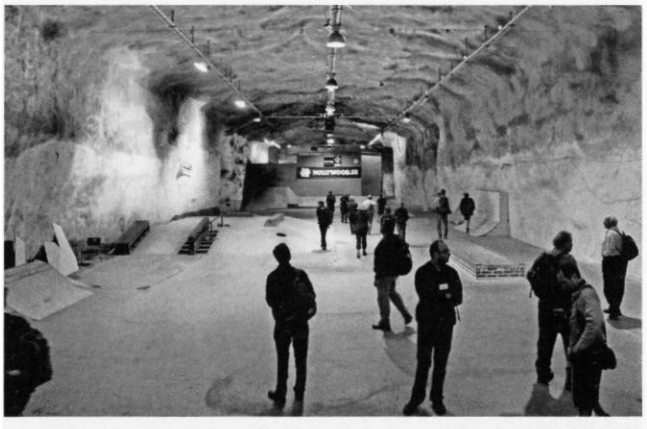
We had free rein over the site and some of our more energetic members had to experience the full depths of all the structures. Part of the park is set up for BMX bikers to develop and show off their skills. Two of the original chambers are now broken into smaller rooms but the original structure is very clear. At the far end of the complex there used to be an underground connection to the factory but this is now blocked off and the 'stub' of the passage is used as a workshop and store room.

Underground feast

Having explored the Cold War site, it was now time to venture into the older and smaller WWII shelter. The



Most of the Cold War section of the SKF Factory is now an immense skateboard park



The scale of the machine halls in the underground SKF Factory is apparent in this shot

shelter has links to the Cold War shelter that are used as emergency exits but we went back outside and re-entered on the level through the original entrance. Owned by the same company, this site has been developed into an underground event space that can be hired out for parties, weddings and club nights. The whole is dressed up extravagantly with lighting, decor, bars and stages to produce a nightclub feel that is licensed for up to 350 guests.

Branded *Berg 211* (Mountain 211) after the original shelter, it is an imaginative reuse of a space that could otherwise be derelict and vandalised. Lars had managed to get us a special deal and we brought in our own food and drink for our evening meal. Not, as some wit suggested, skate and chips but a local delicacy known as *Smörgåstårta* (Sandwich Cake).

This was like a mammoth sandwich, local bread interspersed with creamy fillings; we had fish, meat and vegetarian versions and jolly tasty and filling they were too. And of course a good supply of local beer or something softer to wash it all down. The venue was set up with one huge table seating 35 which made for a very convivial evening. It's a pity it's so far away, as it would make a perfect location for a 40th birthday party for Sub Brit in 2014.

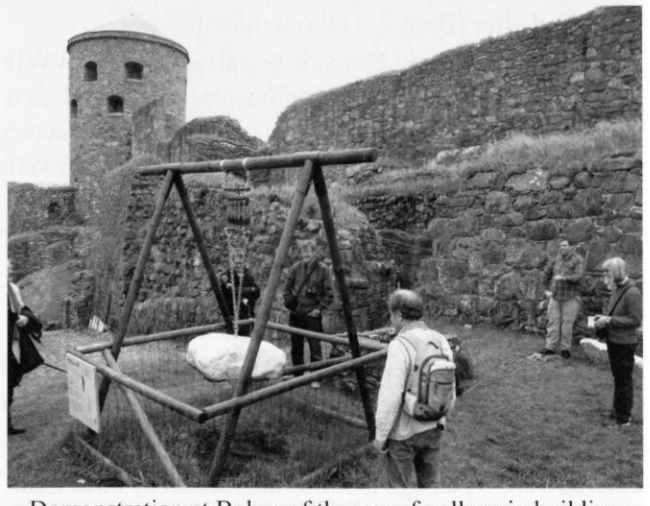
The WWII portion of the SKF Factory provided a superb underground location for our Sunday evening meal

We left the shelter in a downpour and returned to our Kungalv hotel for a nightcap. Following the day's tuition, those of us who were sharp-eyed noticed that our hotel also had its own *skyddsrum* or shelter under one of the wings, now part-used as a gym and part as a store room for the hotel.

Bohus Fortress

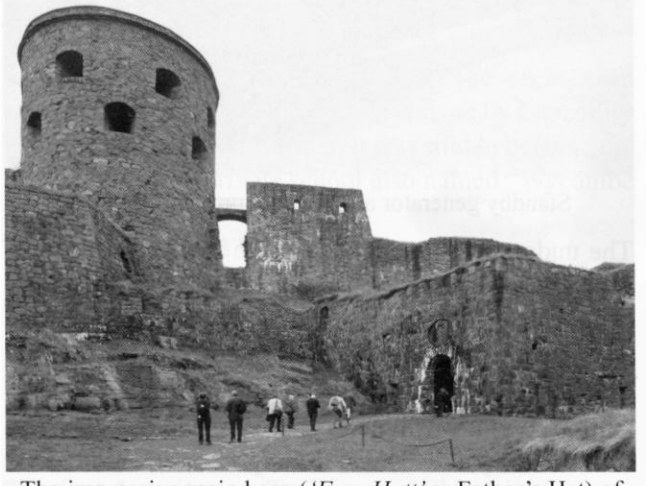
Monday dawned and our first site of the day was within walking distance of the hotel. Bohus Fortress had looked down on us all weekend and stands on a natural strongpoint. It is protected both by being on high ground of around 35 metres, but is also on a island in the River Göta, the channels of the river forming a natural moat. At the time of its construction in 1308 it was on the southern boundary of Norway and remained in their hands until 1536. It then became Danish until 1658 at which time it finally became Swedish.

During its long history, the castle was besieged fourteen times but was never captured. The fortress was officially abandoned in 1786 and rapidly shrank as the local population were allowed to use the stone for their own construction projects!



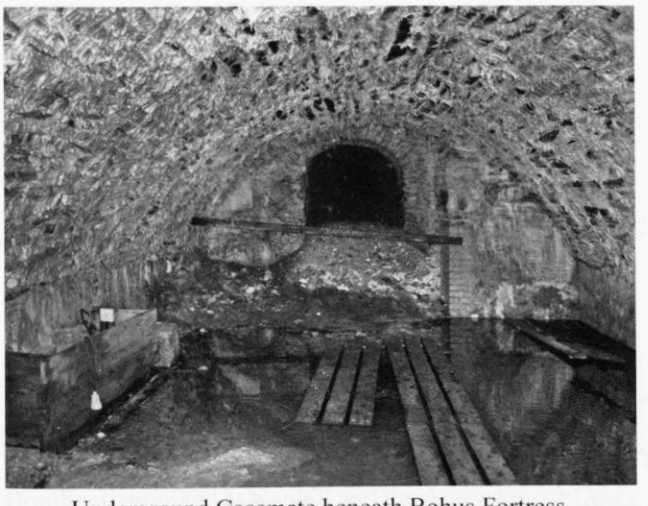
Demonstration at Bohus of the use of pulleys in building construction kept the children amused!

We spent a pleasant hour or so strolling round the ruins which include a massive tower known as *Fars Hatt* (Father's hat). The corresponding Mother's cap (*Mors Mössa*) lay across the courtyard, swathed in scaffolding. *Fars Hatt* is surmounted by a large circular copper roof, green with verdigris. I spent several minutes trying to remove this apparent marker pin from Google maps while working on the weekend's info pack!



The impressive main keep (*'Fars Hatt'* or Father's Hat) of Bohus Fortress, dating from the 14th century

From an underground perspective, two parts of the site were of particular interest. Beneath the *Fars Hatt* tower is a massive mediaeval dungeon around six metres deep. The only access to it was via a trap door in the floor above, through which we were able to peer. A second underground casemate by the gatehouse was opened especially for us by the castle staff. This was the inner part of a casemate that was rediscovered in the 1970s.



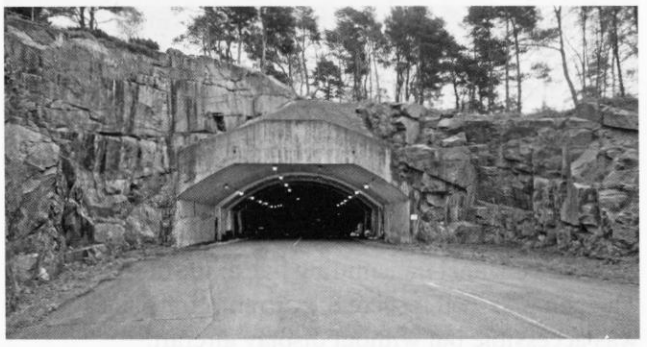
Underground Casemate beneath Bohus Fortress. Photo Martin Dixon

Säve underground hangar

Exercise over, we progressed to one of the weekend's highlights – the underground aircraft hangar at Säve airport. The site was first visited by Sub Brit in 2005 and its condition at that time was described in *Subterranea* number 8. Since that first visit much work has been done to populate and interpret the site.

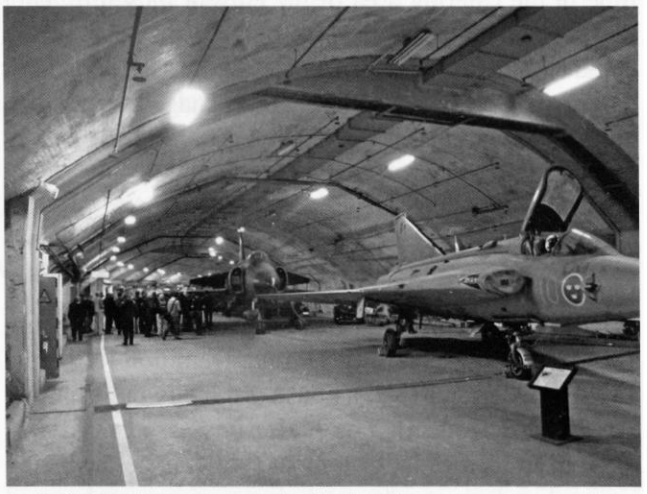
Sweden has a total of seven mountain hangars, two built during World War II and five more added during the Cold War. Säve has two such hangars, one built in 1943 near the current control tower with the protected areas on a level with the taxiways. We were bound for the later and deeper Cold War one, built between 1950 and 1955. Lars has published a splendid book describing the history of all the hangars but sadly it is currently out of print.

The hangar has two entrances – we used the eastern one that has an offset from a sweeping underground approach ramp designed to help deflect bomb blast. It was also used to transport planes to the runway (left), or to the main road network (right) to evacuate the base/hangar if the runways had been destroyed. The entrances are protected behind 90-tonne blast doors which lead to a ramp descending to the hangars themselves 30 metres beneath the surface.



The cavernous entrance to the underground hangars at Säve. Photo Nick Catford

The airfield was home to three squadrons of Saab J29 fighters, popularly known as the *Flygande Tunnan* or Flying Barrel because of their chunky fuselages. Two of these squadrons were surface based, both on the airfield and at dispersals in nearby woods. The third squadron was protected by being based in the underground hangar. The planes would have been towed up the steep slope from the hangars to the surface and it was down this slope that we descended, viewing a dozen or more Swedish planes.



Cold War jets populate the inclined entrance ramp at the Aeromuseum in the Säve underground hangars

As well as the J29 (of which 660 were built) these included many types familiar to anyone who frequented

air shows in the 1970s. These included a number of iconic Saab JA 35 Drakens (Dragons) and the Saab JA 37 Viggens (Lightnings). The ramp and indeed the whole shelter was protected by both water and foam fire systems, with curtains once separating the space to prevent any fire spreading.

Like the civil defence shelters visited earlier in the weekend, the whole complex was built in reinforced concrete, within a larger chamber blasted from the native granite. At the bottom of the ramp, three parallel excavations held eight hangars at right angles to the entrance ramp. Turntables would have allowed the planes to turn the sharp corners with ease.

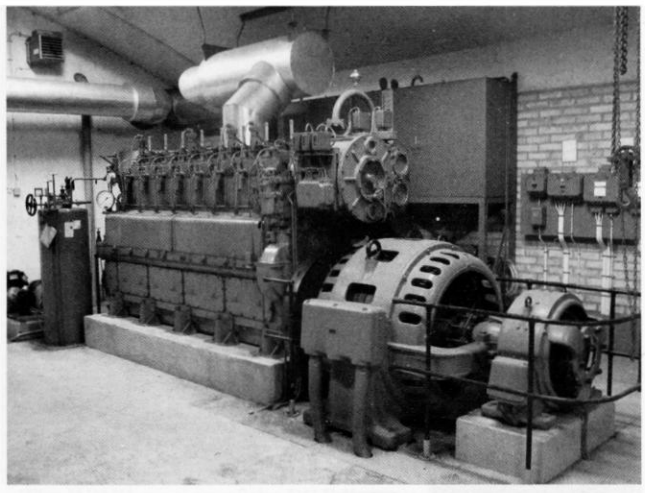
Visitors are able and indeed encouraged to sit in many of the cockpits of the museum fleet. As well as more planes, these underground hangars now hold all manner of displays including helicopters, ejector seats, flying controls and even a collection of flight simulators. The complex as a whole encompasses a massive 22,000 square metres of protected space.

Control and Command

As well as the hangars used as exhibition space, we were able to visit the impressive underground command centre which mimicked the surface tower and as a nice touch still has a channel transmitting live air traffic exchanges. The complex had a second exit ramp for planes which was accessible but without display aircraft.

There is also an emergency exit for personnel, with a double staircase rising through the granite which, although outside the public area, was opened up especially for us. Also 'off-piste' was the extensive plant and machinery area including two massive generators powered by ex-submarine six-cylinder diesels. As well as the usual air filtration and handling and potable water supply, there was also a substantial set-up to supply the water and foam fire-extinguishing systems.

Once more we managed an underground meal, this time in the catering area of the current museum. After this we had another hour or so of free time so members could explore their own particular interests. Your author had a go on a flight simulator and managed to crash on landing but did successfully navigate beneath the nearby suspension bridge at 50 feet or so!



Standby generator at Säve underground complex

The underground hangar closed in 1969, the result of analysis that concluded that the fighter squadrons were better scattered around rather than in a single location. As such, many roads were designated as emergency air-strips to allow dispersal in times of tension.

All too soon it was time to board the coach for the last time and drop attendees at the airport or downtown. We owe an enormous debt to Lars Hansson for the amount of work he put in to make the weekend such a success and to Linda Dixon closer to home for handling the admin side of things. This was our second 'mass' Sub Brit trip to Sweden and hopefully it won't be our last.

All photos by Clive Penfold unless otherwise credited.

Links:

www.o2fort.se/ Oscar II Fort

http://en.wikipedia.org/wiki/Gothenburg_tram_network Gothenburg trams

www.antus.org/HC2.html *Chaffinch*

http://en.wikipedia.org/wiki/Fortifications_of_Gothenburg City bastions

www.antus.org/HCS.html *Sunflower*

www.bunkeberget.org/ Underground skate park

www.berg211.se/ *Berg 211*

www.bohusfastning.com/eng/ Bohus Fortress

www.aeroseum.se/english/index.html Underground hangar

and of course Lars' own site at

www.bunkertours.se

The subway at Merton, SW London

Horatio Nelson [1758 - 1805] shared a home, from 1801, with Lady Hamilton (Emma Hamilton [c. 1761 - 1815]) at Merton Place, a house originally built for one Sir Richard Hotham. The house possessed what was referred to as a canal or a moat (but was neither), and a tunnel under a nearby road giving access unobserved by the public to pleasure grounds the other side. By 1903 the building had been demolished and the grounds built over. The subway outlived the house, and oral evidence from a local resident testified that it has still been accessible after some time after 1845. The estate was sold for re-development in 1823, and the house demolished about 1840.

Source

LAUGHTON, J.K., 1903, Nelson's home at Merton. Wimbledon & Merton Annual 1903, 32 – 44.

RAF Daws Hill: Memories and Protection

Chris Kenney and Rob Jacobs

The town of High Wycombe sits in the bottom of a long valley in the Chiltern Hills northwest of London. Wycombe Abbey is situated to the south, just outside High Wycombe town centre, on the side of the valley known as Daws Hill. The original owner of the site was the family of the present Lord Carrington, whose family traditionally incorporates "Rupert" into the male heirs' forename.

The original mansion, dating from the eighteenth century, is surrounded by parkland laid out by Capability Brown and is Grade II* listed. It was sold to become the prestigious girls' private school also named "Wycombe Abbey".

Role in the Second World War

During World War II the premises were taken over by the 8th United States Army Air Force (USAAF) and became their headquarters, code-named PINETREE. Requisitioned shortly after the USA entered the war in 1942, the school was given just three weeks to vacate the site.

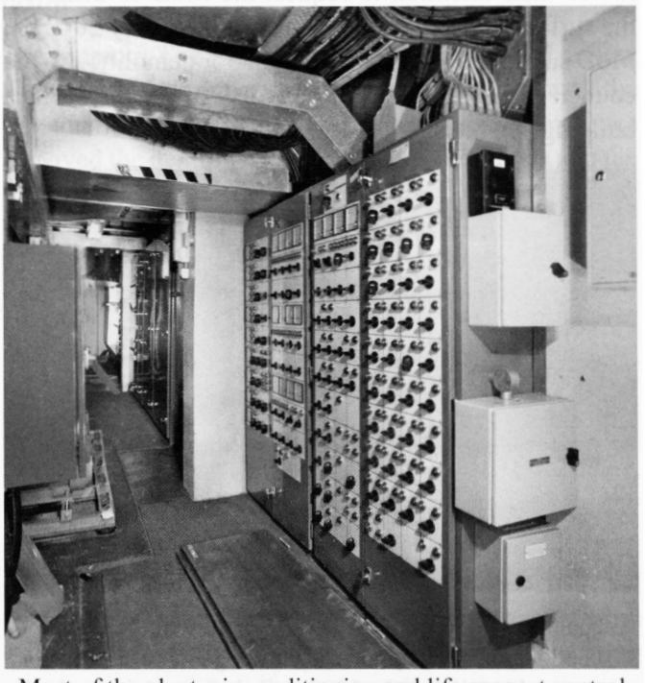
The first American staff who were billeted in the now-vacated school dormitories found, on the dormitory wall above their beds, a bell-push bearing the legend: "Press, if you require a mistress in the night".

It was during this period that a three-level underground bunker was constructed. RAF Daws Hill (as it was officially designated) became the nerve-centre of the USAAF European bombing campaign; the site was no doubt chosen for its proximity to the equivalent RAF Bomber Command bunker at nearby Naphill. At the end of WWII the USAAF/ RAF returned the school building to the Abbey and built a housing facility for service families in the area surrounding the bunker; this included all the usual base facilities.

The declared use of the station now known to us as "RAF High Wycombe / Daws Hill", or "Yankee Base", was as a weather station, but I remember talk of secret radio equipment and missile and nuclear bomb targeting. We now know that the site became the command centre of the United States Air Force 7th Air Division in the 1950s and later the US European Command wartime headquarters. It was also designated as a programming site for the cruise missiles on UK soil.

The general feeling in the town was that with both Bomber Command at Naphill and the Americans at Daws Hill base, it would result in High Wycombe receiving two nuclear hits if the balloon went up! I also remember that there was a tie-up with the large F-111 base at Upper Heyford, Oxfordshire, and US service personnel were always shuttling between the two.

I did once enter the bunker about fifty years ago when I was about sixteen, to help change a large ventilation fan motor. I have vague memories of descending a long flight of steps and entering a underground facility with



Most of the plant, air conditioning and life support control equipment are located in narrow corridors running round the inner walls of the bunker. Photo Nick Catford

blast doors and office rooms with red and green lights above the brown painted doors. We were escorted by an armed US Serviceman at all times.

I do not remember the Americans leaving; it was more a case of their quietly slipping away. I rather miss them.

Chris Kenny

Recent Listing of the Daws Hill bunker

I'm delighted with the decision on 11 October to award Grade II* listed status to the bunker at the former RAF Daws Hill. It's been a long road over the past two years to gain this protection for the site, working with the MoD, English Heritage and Wycombe Abbey School who now own the bunker site.

As a local resident I have been interested in the bunker at Daws Hill for a number of years but in 2011 I was aware that the MoD's lease on the bunker site was coming to an end. Under the terms of their lease they were obliged to return to the school the land which comprised the bunker compound and the approaching driveway from the old base down to the bunker. The terms of the lease were such that the site needed to be returned with no structures, if so requested by the school.

On the site the surface buildings at the time of the handover consisted of a modern warehouse, two pre-fabricated classroom style buildings with no association to the bunker, the two main entrances to the bunker including the decontamination suite and guard hut, three main air vents for the bunker, the emergency exit slope shaft entrance, the generator building and its air-vent structure and the driveway entrance guard hut.

Although I was never told explicitly what the intentions of the school were in relation to the bunker, I understood it was their intention to request the MoD to demolish the surface features of the bunker. In February 2012 the MoD submitted a prior notification for demolition to the council planning office to demolish all of the surface buildings on the site.

Although now devoid of its generators the standby generator building is the only surface building included in the listing. Added during the 1980s refurbishment, it was built externally as there wasn't sufficient room for the generators in the pre-existing bunker. The ventilation towers are also included in the listing. Photo Nick Catford

The bunker is saved

I assume the intent was to seal the bunker away with no surface features but not actually to destroy the bunker. I complained to the council that the demolition notice had not been displayed and that the MoD hadn't listed all of the surface structures in their submitted drawings. At this point I then asked English Heritage to get involved. Since this time I have had regular interaction with the excellent folks at EH and at the school but had little further contribution to the process. Thankfully in the end sense prevailed and this historically and structurally unique bunker has now been saved.

See full details and map at http://list.english-heritage.org.uk/resultsingle.aspx?uid=1411070

Unsurprisingly the school doesn't appear thrilled that the bunker has been listed and what they intend to do with the site is now unclear. I am keeping in contact with the school authorities and will work with them and other members to try and organise a Sub Brit visit at some stage in the future.

Whilst I'm sure others contributed to the Listing of the site and it wouldn't have happened without the excellent work of English Heritage, it just goes to show what can be done with a little persistence and tenacity!

Rob Jacobs

For a full history of RAF Daws Hill see *Subterranea* 9, December 2005

FROM THE ARCHIVES

Cellars or 'crypts' at Rochester, Kent

Considering that one might almost claim that 'no English parish history can be considered complete without a secret tunnel' it is somewhat puzzling that Smith's history of Rochester is almost devoid of any mention of any underground sites! Given that he fails to include a chapter on fortifications younger than the Castle (perhaps on the grounds that they might still in 1927 be regarded as a military secret) there is a complete dearth of mentions of tunnellings and delvings into the chalk which underlies the whole city. The World War II air-raid shelter tunnels and Shorts' contiguous subterranean factory on the right bank of the Medway, of course, were still in the future when he was writing between the two World Wars. Strood, on the left bank of the river, certainly had chalk mines (below brickfields at Frindsbury) but this was outside the city limits.

All Smith (an Alderman, and Mayor of Rochester for the years 1903 and 1904) offers us is brief mentions of 'crypts' or cellars below several of the public houses (the George Inn and the Crown Inn), the Old Vicarage on Boley Hill, and the Bishops' Palace on St. Margaret's Street.

Of these he tells us (on page 478) that …

An old house in the High Street, built about 1300, and then occupied by some person of importance, possessed a vaulted crypt.

That crypt still remains, though the original and probably other succeeding houses over it have been pulled down. The present house is known as the George Inn. The crypt is oblong, fifty-four feet in length, sixteen feet in width and eleven feet in height, and divided into four bays.

Another crypt existed under the old Crown Inn, and dated back to 1300. This house was occupied by Symon Potyn in 1316. Subsequently it was frequently used as the temporary resting place of many royal and distinguished persons.

The Old Vicarage, on Boley Hill, and which originally formed part of Satis House, has a small crypt existing, and probably extended beyond its present limit.

Under the present Bishop's palace in St. Margaret's street, formerly known as the Old Palace, there are two bays remaining of an old undercroft, similar in character to that under the Old Vicarage.

On page 287 he also mentions the crypt at the Cathedral.

Source

SMITH, Frederick Francis, 1927, *A history of Rochester.* London: The C.W. Daniel Company: xvi + 523pp + plates.

Edinburgh's Lost Railway

Julian Allason

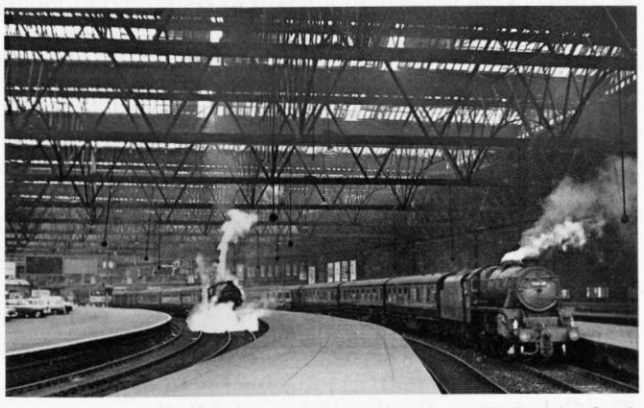
For a century many of Scotland's great social events have played out at Edinburgh's two great railway hotels, the *Caledonian* and the *Balmoral*. Yet few guests can have been fully aware of the warren of tunnels, vaults and secret passages beneath their feet as, in celebratory mood, they approached what resemble two baronial castles. The clue is not just in the railway connection as in what preceded it in a capital with an ancient history of intrigue, imprisonment and escape routes.

Even today no historian or institution, not even the knowledgeable Edinburgh World Heritage organization, can be confident of divining the location and extent of every underground feature. Some, like the abandoned Scotland Street railway tunnel, have been well documented by Sub Brit. Others remain secrets jealously guarded by the families and businesses for a variety of reasons. "Once the secret is out o' the bottle it will not go back in," remarks Lisa Proctor of the Royal Bank of Scotland, who has been taken into more confidences than most.

Four hours from London

It was the arrival of the railways in 1848 that got Edinburgh digging again with tunnels under the western town emerging into the ravine and deep cutting between the Castle on its basalt mount and fashionable Princes Street. The railway remains busy today, linking the Scottish capital with London and thence to Europe by a train service taking just over four hours between London King's Cross and Edinburgh Waverley, a station with no fewer than 17 platforms and a few secrets – and vaults – of its own.

There also extensive cellars beneath the former railway goods yard south and east of Waverley, some of them accessible. Until comparatively recently a kilted porter from the *Balmoral* would spirit guests arriving by rail into the hotel cellars via a private door from the station.



Princes Street station in July 1963, two years before its final closure. The Caledonian hotel overlooks the concourse. Photo from Robert Darlaston

Predicting Edinburgh's underground topography is no easy matter with layers of history and construction overlapping. The Georgian terrace houses in the New Town frequently have cellars extending underneath the pavement and even the road. These have sometimes survived the demolition of the original buildings and the construction in the nineteenth and twentieth centuries of new buildings on a smaller footprint, as the hapless folk laying out the new Edinburgh tram system have been discovering.

A later arrival

It is however around the opposite end of Princes Street that a whiff of mystery still swirls. For the North British Railway had a competitor in the Caledonian Railway which in 1870 constructed a rival station on a V-shaped site by the junction of Princes Street and Lothian Road. At the centre of the V was the concourse of Princes Street Station, its two arms perforated by Roman arches.

From the launch of the terminus, carriages and hansom cabs could be driven through its portals enabling passengers to debouch at street level preparatory to embarking on lines to London via Carstairs, to Glasgow and to that Sub Brit favourite, Barnton, later to become the site of the 1952 Rotor bunker and subsequently a Regional Seat of Government. Shortage of space on the narrow station site led to the excavation of spaces below the concourse. A narrow existing tunnel tall enough for human traffic is believed to have been discovered during the works and connected to the new vaults.

The station was enlarged between 1890 and 1894 to seven platforms handling 250 trains a day under a bayed roof 850 feet in length, and soon became the royal family's preferred point of arrival. Above the archway entrances to the station was then built the Caledonian Hotel, opening in 1903 after construction delays as the *Princes Street Station Hotel*. "It was a cross between Aladdin's cave and a rabbit warren," reported one long-serving employee. "Guests experienced Aladdin, staff got the warren." That description remains true to this day with what has since been known as the *Caledonian Hotel* now managed by the luxury group Waldorf Astoria. A sumptuous £24m upgrade was completed in 2012, updating its Victorian luxury with little loss of atmosphere in the guest rooms and suites.

Emerging from a comfortable bedroom with commanding views of Edinburgh Castle, the modern guest might initially overlook the railway heritage and certainly the underground aspects. For after rail nationalisation in 1948 train services were progressively run down until the final closure of the station in the Scottish rail rationalisation of 1965. The lines were then torn up and part of the West Approach Road built over the trackbed, although the railway bridges were retained.

If, as city lore holds, closed-off sections of railway tunnel remain (allegedly filled with abandoned rolling stock), they are not readily discernible. The approach to the original junction with the main line to Glasgow, which still bores under the city a quarter of a mile to the southwest, would be the obvious location were any length of sealed tunnel to have survived (which to the present writer seems doubtful). Edinburgh World Heritage has records of a smaller tunnel cut across what is now Morrison Street, though not of its current status.

Victorian style survives

Much of the old concourse of the Princes Street Station remains intact, now stylishly adapted for use as the hotel's bar and a meeting point for local glamour. Known as *Peacock Alley*, it retains the Roman arches that led into waiting rooms, station offices and descent to lower levels. The Caledonian Railway Company had adopted as its logo the Scottish version of the Royal coat-of-arms, which is still to be seen carved above two interior doorways that lead from the former station concourse into the residential part of the hotel.

Peacock Alley, the end of the station concourse frequented by first-class passengers, has now been incorporated into the Caledonian Hotel, two entrances to which can be seen on the left. Now a bar lounge, it is again a fashionable city meeting point.
Photo 2013 The Caledonian Hotel

The circular ticket pavilion was burned down in 1890 in a fire that may have been started by a cinder from a steam engine: the inferno was said to have smelled of charred haggis. The old station clock survives, still set five minutes fast to mitigate missed departures. Relaxing over a wee dram here today it is not difficult to recapture the bustle of passengers in top hats or crinolines and the shrill of steam whistles.

Facilities for railway staff, including running water, were maintained in underground spaces along with offices and limited storage of essential equipment including a wickerwork wheelchair for invalids arriving for the Highland cure. Some of these subterranean areas are still in use by the hotel for not dissimilar purposes.

Today the *Caledonian Hotel*, and in particular the *Pompadour* gastronomic restaurant run by the Galvin brothers, is well placed for exploration of both Edinburgh's medieval Old Town and Georgian New Town and serves as a base camp popular with North Americans returning to Scottish roots. The enlightened attitude of general manager Dale MacPhee has opened up the *Caledonian* as World Heritage Trail D with a useful guide leaflet available from the concierge, so exploration is far from discouraged.

A walk through history

The suggested route through the hotel offers unique viewpoints over the city and especially up the deep cutting to Waverley station and in the other direction over the lost route of the Caledonian Railway. The itinerary follows corridors lined with the original 1848 plans for the station, schematics for the 1868 hotel scheme which was never executed for financial reasons, the station's 1890 enlargement, and final construction of the hotel as completed in 1903. The keen-eyed should have little difficulty in detecting clues to underground features.

Both station and hotel have seen their share of celebrities from Laurel & Hardy, who first uttered their catchphrase "Another fine mess you have got me into" over a spillage at table, Gene Kelly who tried out his '*Singing in the Rain*' routine on the marble staircase, the Queen and the Queen Mother, Sir Laurence Olivier and Sir Sean Connery, a regular guest. Porter Billy Garioch, who retired last year after half a century of service, was once ordered to eject a disorderly couple who turned out to be Richard Burton and Elizabeth Taylor.

Welcoming as they are, hotel staff are reluctant to allow guests to roam beyond public areas, no doubt for reasons of health and safety or insurance. "I am aware of tunnels and vaults underneath Princes Street and Princes Street Gardens," the *Caledonian*'s spokeswoman Anwen Dobson says carefully, and then smiles. One feels it would only be necessary to ask nicely to see more. After all, as David Hicks from Edinburgh World Heritage observes, "Heading from Waverley Station north to Leith, you can still see a disused tunnel entrance on Platform 20 and the other end at George V Park near Scotland Street." The Caledonian Railway may have been lost but there is much else to be found hereabouts it seems.

Further information:

The *Caledonian*, a Waldorf Astoria Hotel:
www.thecaledonianedinburgh.com

Edinburgh World Heritage: www.ewht.org.uk

Further reading:
The Caledonian: Scotland's Imperial Railway and *The Caledonian Hotel.*

Special thanks to John Clare and Martin Briscoe for their expert advice.

School Air-Raid Shelters

Chris Rayner

Nowadays there's a renewed interest in school air-raid shelters after a long period of neglect. The emphasis on modern history in the primary school curriculum has led to many schools opening up and re-evaluating, and maybe even growing to love, the dank wartime shelters in their grounds.

Many survived the immediate postwar period and subsequent development pressures by either being out of the way, or too much trouble to demolish or fill in, or being seen as useful for groundkeepers' storage. Some small above-ground shelters have occasionally been converted to classrooms, though the costs of new openings in the heavily reinforced concrete walls can be a nightmare for school governors or their contractors if they haven't done their research.

History lessons

The fiftieth anniversary of Second World War events in the 1990s was a particular impetus for schools around the country to dust down their shelters and open them up for visits by their own and other schools' pupils. Schools in Ipswich, Tunbridge Wells, Limpsfield and Brighton are among those with regularly visited air-raid shelters on Heritage Open Days and by arrangement at other times.

Schools had an advantage over shops, factories and commercial buildings as most had playgrounds or playing fields to put a shelter on or under. Few schools made any preparations in the late 1930s however, for like most public and private concerns they were waiting to see how events turned out, and until they received official guidance and a clear obligation to act.

The Board of Education circular "Air Raid Precautions in Schools" issued in April 1939 required that "during times of danger children should not be assembled in groups of more than 50 in any one protected room or compartment". It called for shelters to be provided away from the school, under playgrounds or playing fields, and gave structural requirements and recommended fixtures and fittings.

The circular stated that all schools would be closed for a week in the event of a national emergency, while in evacuation areas they would remain closed. Where they were reopened at the discretion of local education authorities they were to provide shelters and never send children home during raids. It also set out minimum space standards, such as a bench width of at least 28 inches (710mm) for each child, having a minimum gangway width of 2 ft (600mm) between seats on either side, and a clear height of at least 6 ft (1830mm).

War came in early September 1939 and Operation Pied Piper, the voluntary evacuation from cities of nearly a million children together with other vulnerable groups, was put into effect and carried out in four days. But the expected immediate "knock-out blow" by the Luftwaffe didn't happen, and during the many following months of the Phoney War a large proportion of these evacuees returned home.

Schools are requisitioned

Schools were allowed to reopen if they had an air-raid shelter, though this was in many cases difficult as nearly two thousand schools had been requisitioned as ARP headquarters, Rest Centres, or for other functions. The lack of schools led to children running wild on the streets.

The children at Limpsfield School in Surrey, in a rural location on a heath near to Redhill, instead had a more wholesome brisk run across the cricket ground and then through a field with barbed wire, for their shelters were 600 yards away from the school. They were instructed to lie flat if they heard aircraft overhead.

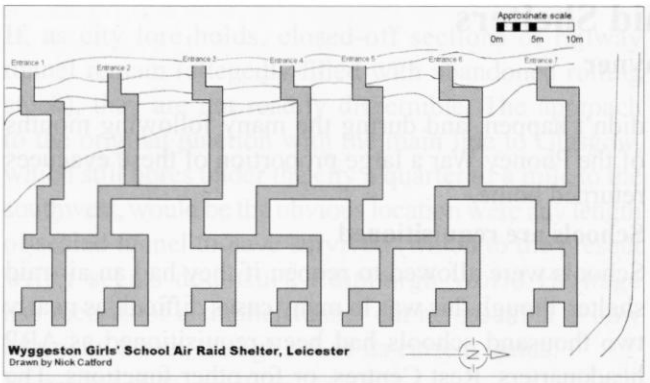
Entrances to the Limpsfield shelter

On reaching the shelters they found six roughly parallel unlinked trench shelters, half cut into the ground and with the excavated earth thrown on top, and they were presumably split up on the basis of year groups. The shelters have stepped entrances at one end and laddered escape hatches at the other, and are formed of concrete. Strangely, they are misaligned and do not appear to have been set out accurately in relation to one another, a basic first step one would have expected any workman to follow.

More common layouts for school shelters included extended zigzags or four-sided closed loops (the Slade school in Tonbridge, Kent, which is featured on the SubBrit website, has at least one of each suggesting more complexity in the choice of shelter form than might otherwise be expected). These would have narrow passages with 90-degree bends every 40 to 50 feet or so to provide blast protection and ensure compartments had no more than fifty or so occupants.

Fixtures and fittings

Corners and toilet recesses often exceeded the limitations of the precast concrete kit of parts and required some poured concrete, recognisable by shuttering marks and the lack of panel joints. Shelters often have very similar features, such



as pairs of angled gas-curtain frames at entrances, remains of bench support brackets, and drainage sumps.

In the centre of Leicester, the shelter at Wyggeston Girls' School was in the northeast corner of a gently sloping site and was completely above ground at least on two of its faces. Despite this it was reported to flood badly and had to have pumps and heaters installed in November 1940 to keep it usable.

Water seems to have been a problem in a number of Leicester trench shelters. Our visit was in February 2013, a week before its demolition, and a strong impression was that the passages had a reasonable fall towards the seven west-side entrances. It was hard to imagine it flooding. The floor was made of concrete slabs spanning between concrete joists embedded in the sticky mud natural floor, and a land drain was visible under one exposed section. Like all of the Leicester Corporation shelters seen, this one was built out of vertical precast concrete panels, with side ribs corresponding to the ceiling ribs.

Entrances to the Leicester Shelter

Although none of the slatted benches referred to by old girls remained, there were other unusual features. In particular the oversized gas-curtain surround found by several of the entrances, but in each case only ever one per entrance and never a pair. Further into the shelter some ventilation ducting wrapped in chicken wire remained together with the remains of a fan and the handle used to operate it manually.

Exit this way

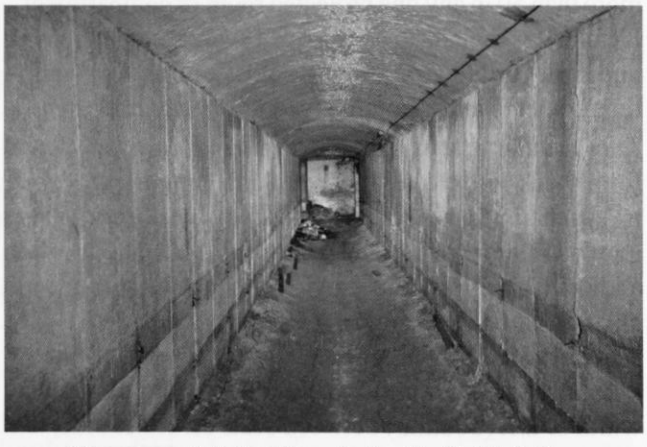
A primitive wooden ladder laying on the shelter floor near one of the sealed emergency exits was unusual, since these were usually metal, though it is possible that this came from postwar storage. There was some intriguing signage, some nicely painted red "First Aid" signs from the war years, and then poorer painted yellow arrows which have been interpreted as postwar. And throughout the shelter, wherever the supporting timber cross beams had collapsed, electrical wiring dangled across the passages trapping visitors like spiders' webs.

Gas curtain surround in the Leicester shelter

Affectionately known by the girls as "the hump" when they filed out to it in wartime drills, the shelter seems never to have been put to the test. After the war it had a period of use by the local fire brigade for smoke training (who probably painted the arrows to indicate the way out) and then became a refuge for foxes. Leicester University's archaeologists arranged for its deconstruction as part of the final stage of their recording process, simulating in reverse its construction sequence.

Yorkshire building society

A surviving underground shelter at a school in City Road, Sheffield, is very unusual in having a dished floor which seems to almost exactly mirror its vaulted ceiling. Like many school shelters, it has an extended zigzag plan with entrance stairs and a small toilet recess to every other corner.

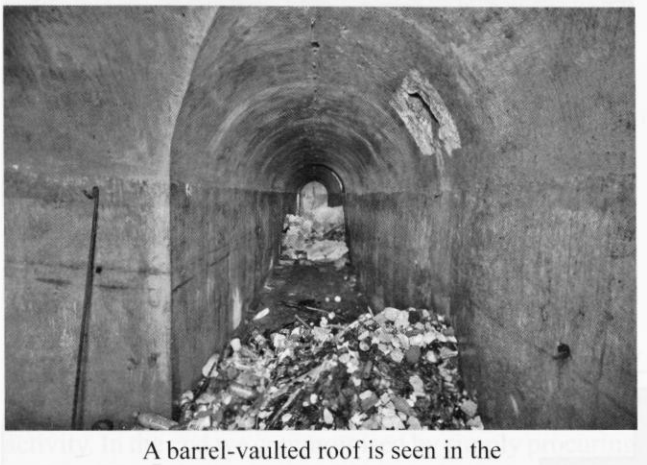


The unusual dished floor in the Sheffield shelter

The bench seats and backrests have gone but many of the timber gallows brackets remain, suggesting the latter were less easy to reuse in the postwar period of timber rationing. Gaps in the whitewash of the walls reveal where they were fixed. The dished floor appears

to anticipate leaks which would have drained down the relatively steep slope to the north end; it may have been covered with timber-slatted duckboards when the shelter was in use.

Another school shelter in the southwest of the city is much larger. King Edward VII School is a stately early nineteenth-century Greek Revival mansion, purpose-built as a school for the sons of Methodist ministers, with extensive shelters under its large front lawn called "The Close". An enthusiastic team at the school has been trying to secure funding to reopen these passages, which would include providing disabled access at one end. Inside the shelter the concrete structure is cleaner and the barrel-vaulted roof is an almost exact semicircle, with well-formed groins at tunnel intersections.



A barrel-vaulted roof is seen in the King Edward VII school shelter

Traces of the original colour scheme remain: a grey-blue ceiling and orange walls, still clear in parts. Piles of old drinks bottles and cans form occasional small mountains on the shelter floors, having been pushed down ventilation holes by generations of postwar pupils.

A letter from the Headmaster to parents dated 13 September 1939 advises them that since the school "is in a non-evacuable area, the Board of Education Regulations will not permit it to be used as a school until gas-proof, splinter-proof and blast-proof trench shelters have been erected." He tells them that while this work is in hand, the main school building must close and the masters will "go to the boys". The school would be temporarily split into five smaller units scattered around the city, meeting in yet smaller groups in parents' homes.

Once built, the shelters were also used by the local ARP, who had a cleansing station for rescue teams with twenty showers (anticipating the need to clean off after gas contamination), ten urinals and a triage station.

Sussex by the sea

Whitehawk Primary School's shelter in Brighton was built in the cut-and-cover method, being relatively quick and cheap to throw up while offering some blast protection. It had brick walls and flat ceilings of poured concrete, the clean board-marks suggesting an early phase of the war when shuttering timber was not rationed.

Lightweight ungalvanised steel framing was irregularly fixed internally with the intention of giving extra resistance to collapse, a problem of many trench shelters being that ground shocks from underground bomb detonations could flex the walls and lift up the lightly connected roofs following which they would collapse onto the occupants.

The Whitehawk School shelter in Brighton has regular open days

Oral history records at Whitehawk School indicate that a large part of the construction works, presumably principally the excavation and covering-over work, was carried out by local volunteers, almost certainly the parents of the schoolchildren who would be sheltered. Completed in January 1940, the shelter was then used almost exclusively for children during school hours, and only once by sheltering mothers who were collecting their offspring.

The shelter is parallel with the school to allow its seven original entrances (only two of which survive today) to be used in the quickest manner. Inside there are two interconnected parallel tunnels, and vertical escape shafts should the school-facing entrances be blocked. Earth from the excavation is piled over the top, enough hopefully to soften the impact of any debris from nearby explosions.

Kent Underground Research Group (KURG)

The air-raid shelter at Clarendon House School in Ramsgate is one of the most unusual found. At first it appears to be a two-level shelter, with a lower section comprising a pair of parallel unlined chalk passages with short stub passages between. Above this and linked by a stairway is an underground precast concrete trench shelter. The two levels and different construction techniques however reflect different ages, the lower level being First World War and the upper dating from the Second World War.

The unlined chalk is reminiscent of the nearby Ellington School shelter discovered and recorded by KURG several years ago, which was also found to be First World War in origin. This shelter also had a rich vein of pencilled

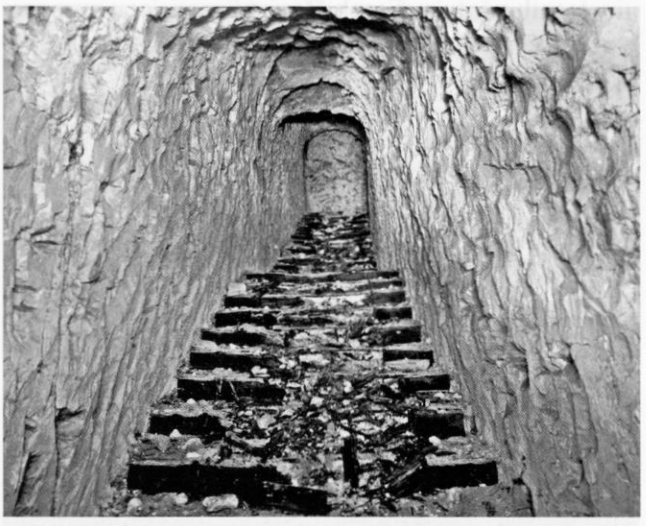
The lower unlined level at Clarendon School with the remains of benches along one side wall

graffiti, including drawings of Popeye and disparaging remarks about the girls of a neighbouring school: "St Georges are stacked painted chads."

Graffiti in school shelters is usually quite rare presumably due to the watchful eyes of teachers. A girls' grammar school on the opposite side of the county has very extensive precast concrete-lined underground shelters, both at the front and behind the school. They are largely flooded today, but one of the most interesting features was the discovery of a pencilled 6:8:10 triangle, evidence of an impromptu lesson in geometry.

Many other articles about Air-raid shelters have been published in Subterranea (see issues 11, 16, 19, 20, 23) and specifically about air-raid shelters in schools (issues 20 and 24).

Photos by Chris Rayner unless stated



It is unusual for schools to have deep shelters. The Ellington School shelter was built during WWI and re-used in WWII. There are three entrances accessed by wooden steps as seen here. Photo Nick Catford

Before you go underground for the last time.....

Many members already kindly make donations to support specific projects, but have you considered including Sub Brit in your will?

In addition to any monetary bequests, you might wish to consider the donation of artifacts, books or research papers relating to underground topics.
There are sad tales of valuable paperwork being binned by relatives who don't share our passion.

Your bequest could help Sub Brit to continue with our research and documentation of underground sites, and ensure that this important part of our history – some of it fast-disappearing – is fully recorded.
As we are a registered charity, any bequest to the society could even help reduce your overall inheritance tax bill.

Adding Sub Brit to your will should be straightforward – our registered address and charity number are included at the beginning of every edition of *Subterranea*.
You don't have to tell us of your plans but if you'd like to, please contact our Treasurer, Tony Radstone at our registered address.
We can then be prepared for what we hope will be a faraway day.

Sub Brit at NAMHO Conference – June 2013

Siafftiau mwyngloddiau – cadwch drau!*

Tim Wellburn

The NAMHO (National Association of Mining History Organisations) Conference this year was based at Aberystwyth; Clive Penfold, Richard West and I made the happy decision to go.

The Conference involves parallel activities: lectures, and surface and underground visits. The field visit programme, which extended over three and a half days, encompassed eleven mines, all within the hinterland of Aberystwyth. Most of the visits were for 8-person groups, and were repeated morning and afternoon on both Saturday and Sunday.

The visits have to be booked in advance from a provisional programme which gave a brief indication of what might be encountered at each mine, in terms of the nature of the mine and its artefacts, and also the level of challenge in gaining entry. This ran from "Easy" through "Moderate" to "Technical", the last of which ranged from "some crawling and climbing" to "advanced SRT skills with belays and deviations" and "swimming in deep water"!

Martin Dixon advised us inter alia that "walk-in" probably involved a degree of crawling and "very wet" often meant wading through at least chest-high water, and so I consulted Mike Stace on the proper kit for such activity. In the end we compromised by simply procuring waders. These kept us dry, although they proved to be slightly constraining in negotiating some obstacles.

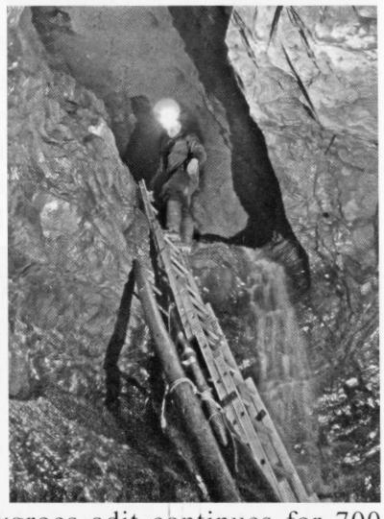
With considerable help from Catherine Mills at the University of Stirling, we finally booked up a set of five underground visits over three days, accepting thigh-deep water, a bit of scrambling and some ladders. By way of contrast to all this subterranean activity, we also indulged ourselves with an initial ascent – a Friday afternoon ride on the Vale of Rheidol narrow-gauge steam railway, which spectacularly clings to some narrow rock-cut ledges on its stiff climb to Devil's Bridge.

In the event, the underground programme proved a bit of a moveable feast, partly because, despite the best efforts of Roy Fellows and others, NAMHO had been unable to secure access to some of the proposed sites. However, we also discovered that we had been over-ambitious in booking one trip: the skipway by which we had thought to enter Cwmystyth Level Fawr turned out to be an 80° shaft requiring full-SRT rig – and skills quite beyond us! However, with infinite goodwill, the organisers and volunteer trip-leaders sprang to our assistance and created two bespoke replacement underground visits. This spirit of friendly and willing helpfulness permeated the Conference.

Pontrhydygroes Deep Adit

Mining in this area was predominantly for lead, although zinc was also commonly found, and occasionally silver, in the same mine. Our first underground encounter, led by Hugh Ratzer, was Pontrhydygroes Deep Adit (SN 739722). The elegant portal is engraved "THIS LEVEL WAS COMMENCED AD 1785".

This is a long (1680 metres) straight southerly-heading level, dug mainly as a drainage adit for existing mines: Logulas, Penygist, Glogfach and Glogfawr, the last working up until 1927. Pontrhydygroes had an interesting history in that two successive owners had each abandoned work not much more than a metre short of striking significant lodes! Logulas is reached after about 780 metres, where a section of plastic piping allowed us to negotiate a collapse, and Penygist shortly after, where levels branch off east and west, the latter leading to stopes.



Level discontinuity, approximately 1560 metres from the entrance, Clive Penfold is ascending the ladder. Photo Tim Wellburn

The main Pontrhydygroes adit continues for 700 metres to the foot of a small waterfall marking a height discontinuity of approximately seven metres. Roy Fellows has concluded that this was deliberate, in order to drain Glogfach's 118 fathom level. The adit then intersects the Glogfach and Glogfawr workings, beyond which silting and collapse prevent further exploration. Two relatively intact wooden wheelbarrows lie abandoned at this point.

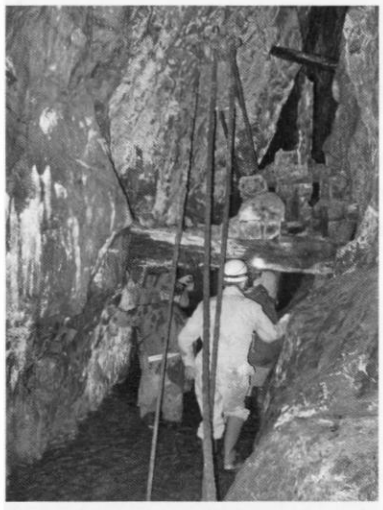
Pontrhydygroes remained physically memorable for a long while afterwards because of the muscles deployed negotiating a section of some 200 metres silted up to about one metre headroom!

Temple Mine

In the afternoon we visited Temple Mine (SN 748793), led by Alan Robinson, who also provided a very useful fact-sheet, on which this note draws. This trip provided a further unwanted work-out as, in Welsh sunshine (but clad for underground temperatures), we first had to reach and cross the Rheidol Gorge in which the mine is situated.

Named after three large standing stones supposed to mark a Druid temple, this mine commenced in 1876 but was largely defunct before the end of the century. Only one small lode produced any good ore. Production peaked in 1881 when some 100 tons of lead ore and 20 tons of

zinc ore were extracted, with the underground and surface workforces reaching their maximum totals of 33 and 18 persons respectively around this period. The mine was worked from three adits driven westward, with an internal shaft sunk from within Deep Adit, where there remains a massive underground angle bob and associated rodding, installed to pump the shaft to the 20-fathom level. Power was provided by three waterwheels, all fed by a 2 km-long leat cut along the side of the Gorge.



Angle bob and pump rodding in the Deep Adit. Photo Clive Penfold

The biggest wheel, 40 x 4 ft (12.3 x 1.2m), was located immediately outside Deep Adit, on the edge of the Gorge. This wheel also wound the shaft, powered a compressor and a hauled a surface tramway incline – of which there now seems to be no trace. A slightly smaller wheel, 30 x 4 ft (9.2 x 1.2m), drove a stone crusher and the third, of 14 ft (4.3m) diameter, the dressing machinery. Evidence of the leat, some buildings and other surface works remains.

Saturday evening was marked by the very good and well-attended NAMHO Conference dinner (and a further opportunity to peruse Mike Moore's tempting display of books). It also occasioned the welcome appearance of Mike Stace, risen from his sick-bed, bringing the (known) total of attending Sub Britters to five.

Ystrad Einion Mine

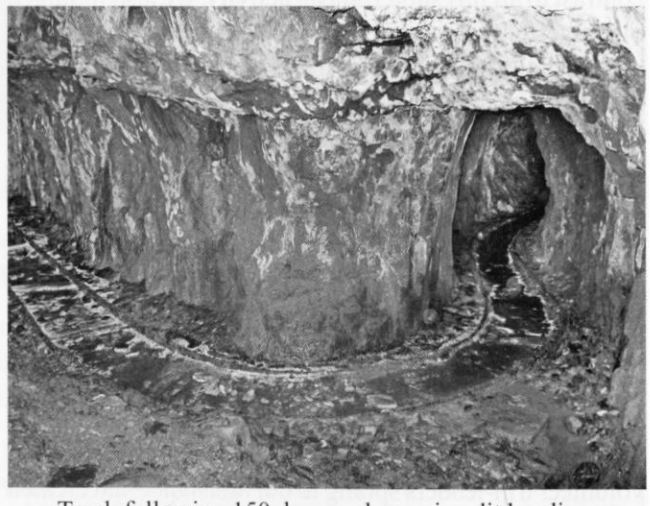
On Sunday morning, Dave Seabourne took us into Ystrad Einion (SN 707940). This was predominantly a copper mine – although it also produced lead, zinc and a little silver. *Adit Now* states that it was certainly worked by the Company of Mine Adventures from about 1700, but was then abandoned after 1760 until the mid-nineteenth century. It was acquired in 1870 by a Mr Mason and then worked consistently – although never profitably – until closure around 1900.

The mine has four accessible levels, of which we explored three, including No.4, which is accessed by a ladder from the engine shaft, the portal having long collapsed. This shaft, which we had identified on the surface and later crossed at No.3 adit level on infill, gave us pause for thought when we subsequently learned that it had been sunk to 50 fathoms (92m). The glory of this mine is an underground water wheel, installed by Mr Mason

Underground waterwheel. Photo Nick Catford

in a worked-out stope in No.3 level, to order to provide pumping and haulage. This was fed from a launder in No.2 level.

Extraordinarily, this waterwheel remains in situ and largely intact: quite the most impressive artefact we encountered in any of the mines we visited and an undoubted highlight of the weekend. There are also lengthy sections of track still in place underground, including a remarkable tight-radius curve where the adit abruptly changes direction through some 150 degrees. The mine also has extensive and well-preserved surface works including the crusher buildings, waterwheel pits, bundles and circular magazine. A contemporary (C.19th) account marvelled at these works but presciently wondered where the ore would come from to feed them.



Track following 150 degree change in adit heading. Photo Tim Wellburn

Bwlch Glas Mine

In the afternoon, Vicky Robinson kindly provided us with the first of our two bespoke underground visits: a comprehensive exploration of No.1 (Upper) Adit at Bwlch Glas lead and silver mine (SN710877) – while the main

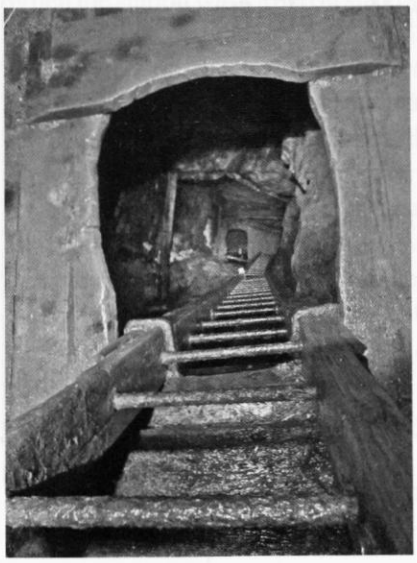
("technical") group entered Deep Adit to explore the stopes and internal shafts and headgear that provided access to the Main Lode at the 10, 20 and 35 fathom levels. Once again, an excellent 'Robinson' fact-sheet provided a wealth of information, which informs this account.

No.1 Adit, top of internal shaft to Deep Adit. Photo Tim Wellburn

Trials at Bwlch Glas had commenced in 1889, and No.1 Adit was driven to cross-cut two parallel lodes outcropping on the hillside. This level was worked until the end of the century, but the total workforce rarely exceeded twenty, with output peaking in 1897 when 50 tons of mineral ore, 26 tons of lead and 194 ounces of silver were produced. The period of significant production came with the exploitation of Main Lode between 1909 and 1916 by Scottish Cardigan Lead Mines Ltd (later Cardigan Mining Co Ltd).

The conspicuously 'modern' concrete mill and dressing area buildings date from this period. Production peaked in 1910, with 208 tons of mineral ore, 154 tons of lead and 1,248 ounces of silver raised. The workforce also reached its maximum in this year: 135 underground and (a quite exceptional) 169 on the surface. By 1923 it had closed.

Notwithstanding its relatively meagre yield, No.1 Adit is characterised by generous dimensions – which if anything increase the further one enters the mine – and



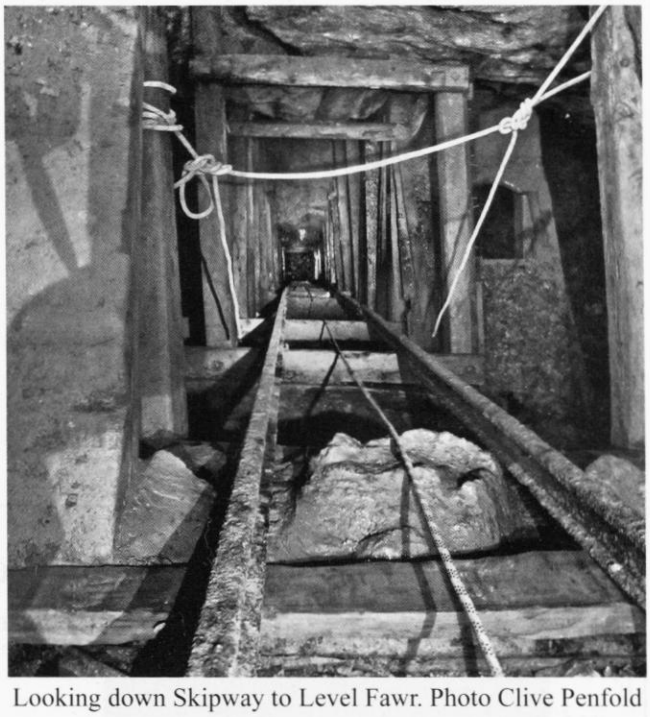
No.1 Adit, manway ladder to Deep Adit. Photo Tim Wellburn

by a plethora of exploratory, but evidently unproductive, blind headings. We looked longingly at – but then carefully negotiated our way around – the top of the underground shaft to Deep Adit with its manway ladders and platforms still in place. Interestingly, because the mill was positioned above Deep Adit, ore was wound up for processing. Power was provided by two Fielding & Platt gas engines, replacing an earlier waterwheel.

We rounded off the day by a further rail ascent: this time on the Aberystwyth cliff railway, taking tea at the top before descending to inspect the old pier (wonderful decaying Victorian underpinnings; horrific topside) and then the remains of the once-impressive castle, before Wetherspoon's called – which it seemed to do for many of the NAMHO fraternity.

Cwmystwyth

Monday, the culmination of the Conference, was devoted to Cwmystwyth lead mines (SN 802745), to which access had only just been secured through the recent 2013 transfer of ownership to Cambrian Mines Trust. Described in *Adit Now* as "probably the most important mining site in mid-Wales", the mines are thought to date from Roman times, with first recorded history in 1184, and closure as late as 1950.

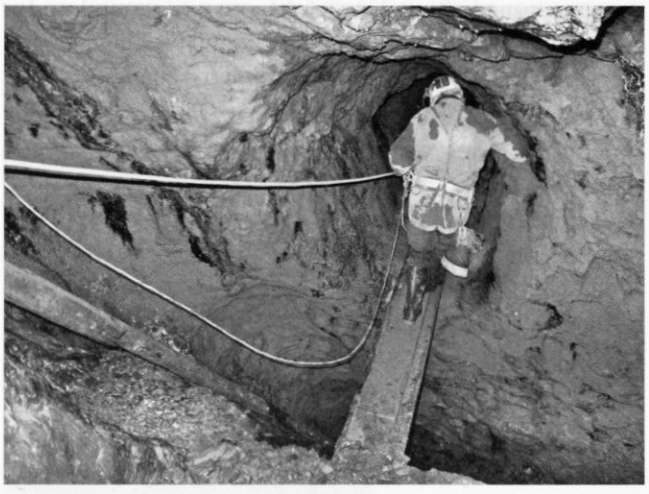


Looking down Skipway to Level Fawr. Photo Clive Penfold

In place of our mistakenly-booked Level Fawr SRT trip, and in lieu of the alternative advertised programme which included too much surface exploration for our immediate interest, Steve Holding very kindly provided us with a bespoke underground trip of some of the upper levels of Cwmystwyth.

We entered the mine through a solid stone-built portal, set beneath waste tips adjacent to some substantial mill remains situated just above the valley floor: a grey, desolate place. The water in the outer reach of the adit was thigh-deep but our waders kept us dry and, once

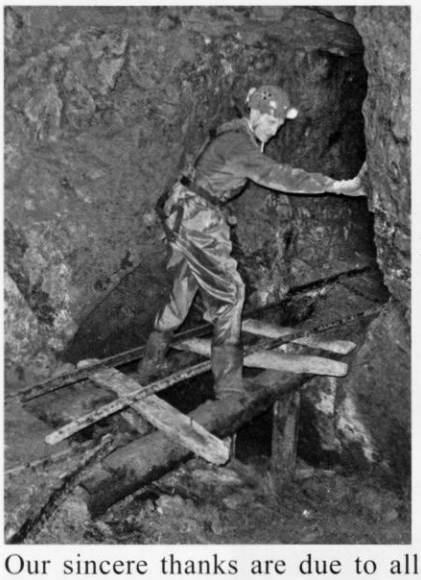
we had negotiated a roof fall via a now-familiar section of plastic piping, the rest of the mine proved to be well drained. We then embarked on a fascinating, and frequently exhilarating exploration of the interior, at several different levels.



Cwmystwyth: Plank across the abyss. Photo Clive Penfold

This involved negotiating numerous stopes, including a very long ascent of an original ladder, numerous scrambles and one crossing of a seemingly bottomless abyss on a narrow plank (we roped up for that!). Many of these stopes are stacked with deads, the weight of these and the structural integrity of the supporting timbers providing interesting subjects for conjecture. In one place, different levels are curiously connected by a small twisting passage, which may be an older working, used at some period for running air and water(?) pipes between various parts of the mine; we clambered up as far as our wader-constrained flexibility allowed.

We were also able to admire the Level Fawr skipway, with its rails still in situ, extending from our level both up and down, out of the range of torch illumination. The SRT group subsequently arrived and, with some awe, we watched as, one by one, they disappeared into the lower depths of the mine. Back at the adit mouth, blinking in the sunshine, Richard West pointed out a 'Danger of Death' sign, with some remark about the advisability of "reading the small print first"!



Tim Wellburn crossing the rail bridge. Photo Clive Penfold

Our sincere thanks are due to all in NAMHO who organised an excellent Conference, gave us such help in booking trips, adapted the programme of visits to give us the best possible experience – and then delivered it. We shall be attending NAMHO 2014 and strongly recommend it to other Sub Britters.

SOURCES

This report draws on the notes produced by Alan Robinson and verbal information provided by other trip leaders, supplemented by reference material from *Adit Now* (http://www.aditnow.co.uk/mines) including Roy Fellows' note "Glogfach and Glogfawr". Any errors are mine.

The standard reference, recommended by Mike Moore, is: David E. Bick, *The Old Metal Mines of Mid-Wales* (published in six parts).

www.namho.org

* **Siafftiau mwyngloddiau - cadwch drau**: Mine shafts - Stay away!

Health and safety in ascending or descending shafts

Whether you are ascending or descending a vertical shaft, by whatever means (fixed rungs or ladder, wire ladder, SRT etc) there are some elementary safety rules.

[1] Rope up

[2] Ensure the person belaying you knows how to do it and is him or herself anchored at the surface

[3] One person at a time

[4] Raise and lower loose kit separately

[5] Don't lean out and look down on a person climbing

[6] Don't look up

[7] Learn and use the climbing calls

Underground in WWII – Halstead In-Station (dugout)

Evelyn Simak and Adrian Pye

Much has already been written about Churchill's Auxiliary Units in World War II whose training was carried out clandestinely under Colonel Colin Gubbins at Coleshill Estate near Swindon – see *Subterranea* 28 (December 2011).

These secret Auxiliary Units included a 'Special Duties Section' (SDS) whose purpose, following a German invasion, was to stay in their normal jobs and gather intelligence. In other words they were spies. Their intelligence would have been communicated via battery-powered transceivers (TRDs) to a signals control station, often known as an In-Station (also referred to as Zero Stations).

Secret underground bunkers

Near Halstead in Essex we have located an In-Station that was one of the first three such stations in East Anglia. Crewed by ATS officers throughout the time of its existence, it was operational from 1941 until close-down in the summer of 1944. Like similar stations, the wireless traffic was conducted from a hut, often on an existing Army base and given cover as a Meteorological Unit.

From mid-1942 onwards concealed bunkers or dugouts containing food rations for 21 days, toilet facilities and provisions for battery charging were built near most of these huts, so that the crews could operate closed down for up to three weeks without surfacing if the Germans occupied the area. The Halstead In-Station used the call-sign "Buttercup".

At Halstead, the dugout was built immediately above and partially into a steep overgrown bank located on the edge of a small wood that is bounded by fields. The entrance opening is situated only a few yards distant from the wood's edge whereas the emergency exit opening emerges, in common with many others, onto the slope of bank below that adjoins open fields. The dugout was accessed through a drop-down shaft built from breeze-blocks.

When the station was closed at stand-down, the top row of breeze-blocks and the concrete lip that sealed them from above were knocked off and the broken pieces thrown down the entrance shaft. Several small rectangular recesses can be seen in the breeze-blocks near the entrance opening. They served to support a timber frame to which pulleys for operating the opening mechanism would have been attached. The floor below is littered with broken sections of timber framing, some bearing the imprints of pulleys that appear to have been knocked out.

The exterior of the hatch would have been well camouflaged so as to blend in perfectly with its surroundings, and casual passers-by would have been unable to spot it. A ladder would seem to have been necessary for access, as there is no trace of the presence of built-in steel rungs.

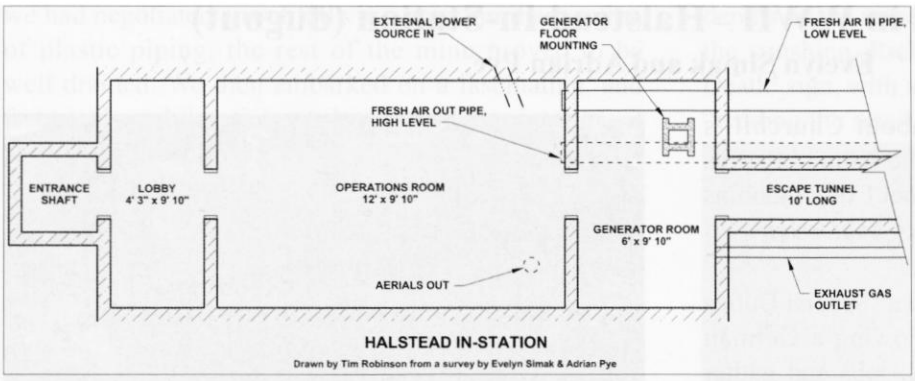
View down the entrance shaft

The counterweight – a length of 95 lb bullhead railway line – was found at the bottom of the shaft, which leads directly into a small anteroom or lobby that in all probability would once have contained a water tank and a chemical (Elsan) toilet. Coming down the shaft, the uninitiated would have found themselves in a small room that to all intents and purposes was used for storage, containing shelves stacked with boxes and tins. This shelf unit, however, was cleverly designed to conceal a door leading into the operations room. A cast-iron pipe, the remains of which are still in place, ventilated this lobby.

The counterweight – a length of 95 lb bullhead railway

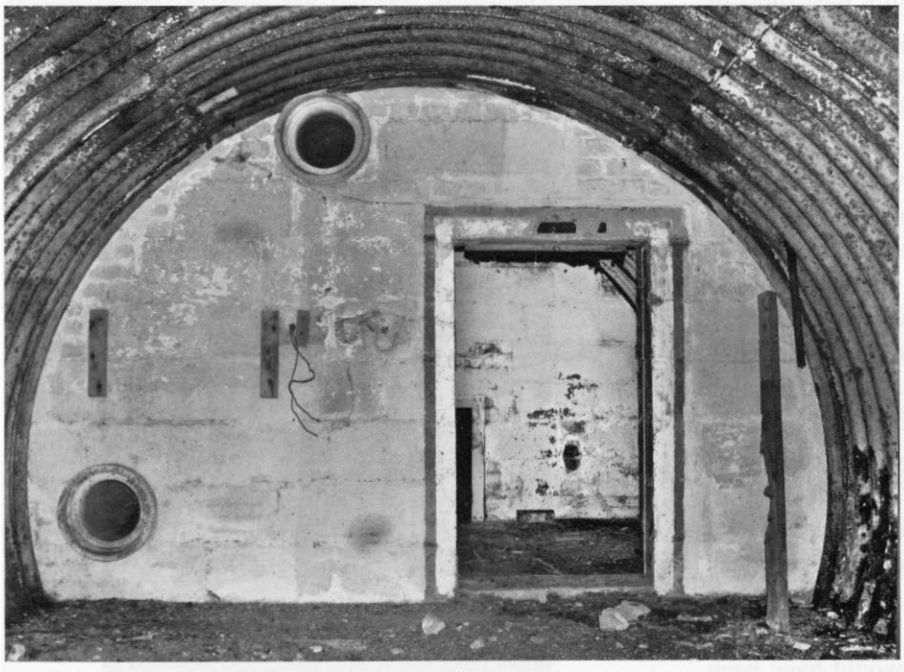
Operations room

The operations room, whose interior walls are painted an off-white colour, was accessed through the secret door in the lobby. Its floor is covered with precisely laid concrete paving slabs which were originally covered by a layer of brown linoleum (some still in situ). In several places the corrugated iron of the elephant shelter is badly corroded and has fallen away, particularly along the


EXTERNAL POWER SOURCE IN
GENERATOR FLOOR MOUNTING
FRESH AIR IN PIPE, LOW LEVEL
FRESH AIR OUT PIPE, HIGH LEVEL
ENTRANCE SHAFT
LOBBY 4' 3" x 9' 10"
OPERATIONS ROOM 12' x 9' 10"
ESCAPE TUNNEL 10' LONG
GENERATOR ROOM 6' x 9' 10"
AERIALS OUT
EXHAUST GAS OUTLET
HALSTEAD IN-STATION
Drawn by Tim Robinson from a survey by Evelyn Simak & Adrian Pye

bottom where it meets the floor. Consequently, sandy soil is trickling into the chamber, partially covering the floor and any small artefacts that might still be lying there. The openings of two large ventilation pipes can be seen in the wall separating the operations and the generator room.

Ventilation in all known In-Station dugouts was supplied in the same way, i.e. by two large concrete pipes, the lower being the inlet, the upper the outlet pipe. Fresh air entered the dugout through the bottom pipe, expanding and rising as it warmed until in reached the top pipe, from where it would have made its way outwards, being replaced by fresh air. This process could, if necessary, be assisted by a fan or by the use of a Tilley lamp (N. Oxenden, *Auxiliary Units – History and Achievements, 1940–1944*, p26).



The operations room
(view towards the generator room and emergency exit)

'1A' can be seen pencilled on the wall beside the outlet pipe and '1B' was written beside the inlet pipe. Obviously, the annotations meant something, but what exactly remains a mystery. Presumably there would originally have been some kind of covers, perhaps wooden blanks, used for covering the ventilation pipe openings for the purpose of noise reduction and also to prevent generator exhaust fumes from seeping into the operations room. Pencilled lines, drilled holes, remains of bolts and wooden battens are evidence of shelves once having been affixed to the wall, and a row of large cable-clips along the ceiling indicates the presence of wiring or of a conduit for the lighting.

An aerial feeder cable, shielded within a metal pipe, enters the room through the roof near the far corner. A second feeder cable, a short length only, was found embedded in a broken piece of concrete that formed part of the construction of the entrance and is now lying at the bottom of the entrance shaft. The presence of at least two feeder cables supports the theory that every wireless link required its own aerial.

One of two two-cored 240 Volt mains power cables

The Halstead In-Station is believed to have had at least five OUT-Stations and it also had a wireless link to an In/Relay-Station at Ousden in Suffolk. A wireless link with the AU Signals HQ at Bachelor's Hall near Hundon, Suffolk, has also been documented. If there is any truth in the theory of there having been one aerial per wireless link, then several more feeder cables could in theory still be found, but since all the original trees are long gone the chances of finding cables or aerials still in situ are nil.

Electric power

Two two-cored 240-Volt mains-power cables entered the operations room through the opposite wall, each one contained within its own ducting. Even when used for heating only, the load would almost certainly have been too high for a single cable to carry, and it is for this reason that two cables were used. As no lighting conduits or cables have survived at Halstead it is not possible to establish whether the dugout had two separate lighting circuits, as has been documented elsewhere.

Lengths of the same type of mains-power cable have been found at the Shipley (West Sussex), Wilton (Wiltshire) and Norwich (Norfolk) In-Stations – the last being the first In-Station where the use of mains power as well as the existence of two separate electric circuits, one powered by 6V batteries, the other by mains electricity, has been documented (E. Simak & A. Pye, *Churchill's Secret Auxiliary Units in Norfolk and Suffolk*, 2013).

One of the original artefacts found on the floor of the wireless room is a fairly large fragment of an unidentifiable khaki-coloured, oil-stained fabric made of heavy-duty canvas, with what would seem to be an adjustable belt at one end. It appears to have been eaten away by acid in parts and is indistinguishable as an article of clothing. What purpose it served has as yet to be determined.

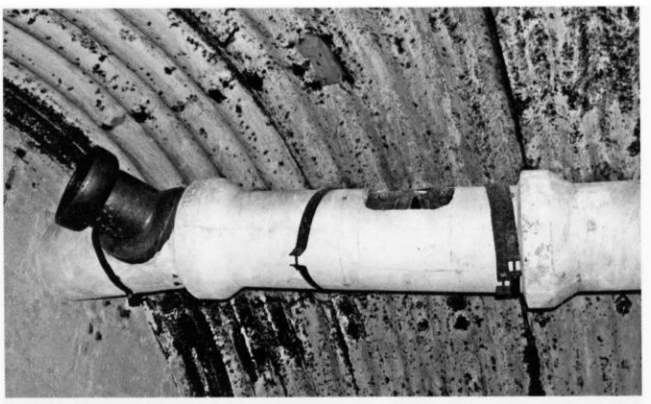
Part of a door frame is leaning against the wall beside the doorway into the generator room, with patches of what appears to be hessian fabric still adhering to it. In all probability this doorway, leading into the generator room, would once have been secured by twin doors – with a raised concrete doorstep in-between the two (in situ). The insides and edges of both doors would have been covered with a felt-like fabric soaked in paraffin oil (Union cloth anti-gas) which provided a tight seal against war gases and the deadly carbon monoxide present in the generator exhaust.

Ventilation

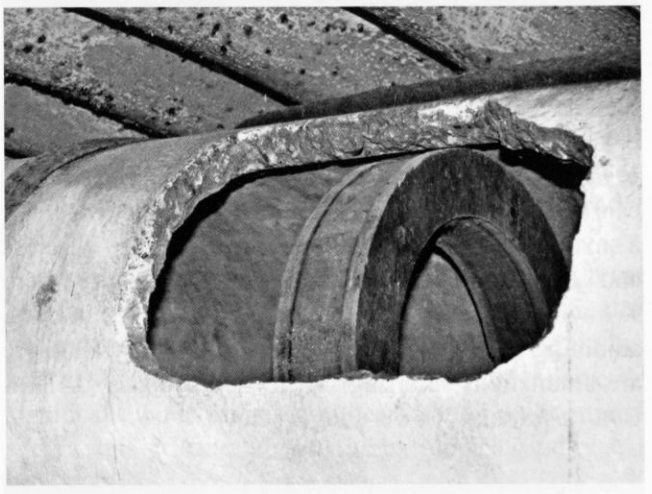
A pair of large concrete ventilation pipes traverses one end of the generator room, sporting characteristic rectangular openings. Screens or covers made from wood or from Union cloth were commonly used for blocking these openings. At Halstead a rectangular piece of slightly bent sheet metal (in situ) served as a cover. It still is firmly held in place by steel circlip-like bands of thin steel with a nut and bolt.

The pipes are painted white and, interestingly and unusually, both have a large section of glazed ceramic pipe, opening into the generator room, coupled onto them. Perhaps these Y-junctions served to create some additional airflow or they helped to smooth the airflow and ensured roughly equal suction from both generator and wireless rooms, or both, as without a doubt did the extractor fan, part of which is still in situ and can be glimpsed within the outlet pipe – an unusual feature that has not previously been documented. The fact that an electrical fan assisted air circulation might have influenced the unusual design of these pipes, which provided the only means of ventilation both in the operations room and in the generator room.

A much smaller ceramic pipe in the end wall still contains part of the generator's exhaust which had been inserted into it. Great care would have been taken to seal it with fire-clay or asbestos matting in order to minimise the risk of any poisonous carbon monoxide gas from escaping



Outlet ventilation pipe with extractor fan mounting



into the generator room. On the wall above it, the word 'CHARGED' can be seen written in pencil – no doubt referring to batteries. Like the adjoining operations room, the interior walls of the generator room are painted off-white and neatly laid paving slabs cover the floor.

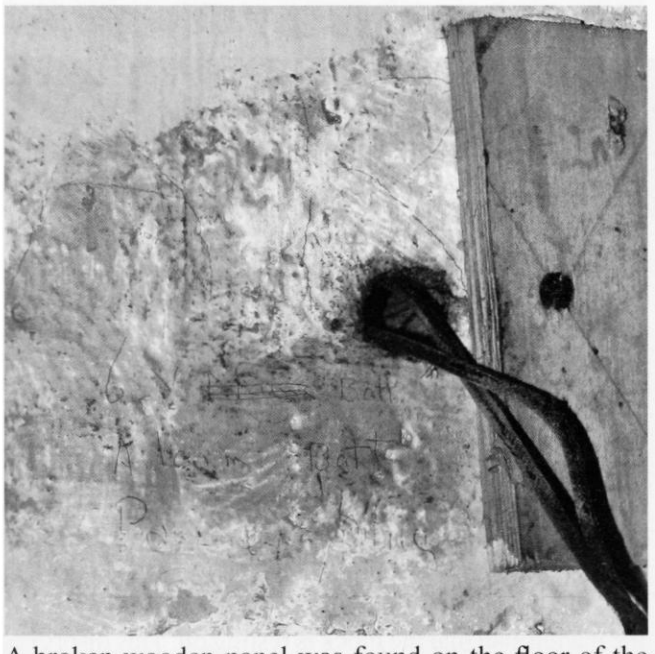
Generator

On the floor of the Generator room, the wooden generator-mounting block is still in place, in its original position. Constructed from sections of 4-inch-square timber, this is the only original specimen known to have survived. Four six-inch metal bolts on its underside, one near each corner, not only prevented it from being propelled all over the smooth paved floor by the generator's vibrations when it was running but also held it firmly in place when pulling the starter cord. The bolts, albeit quite corroded, are still contained within the holes that were drilled into the paving slab that the block is resting on. This disproves earlier theories as to whether generators may have been positioned on shelves or benches.

Refuelling would have been problematic, considering that 4-gallon Jerry cans or 2-gallon petrol cans would have been used, and that refuelling was tricky even when using a funnel. Bearing in mind that the primary source of carbon monoxide is from exhaust fumes and that it is a colourless, odourless, tasteless and initially non-irritating toxic gas – and hence very difficult for people to detect – the notion that generators were ever situated in the operations room is unsupported.

Wooden generator block

The generator room is of particular interest not only because of the unusual ventilation pipes and the original artefacts still in situ but also in that a number of handwritten annotations can still clearly be read. '2A' can be seen written on the joint of the outlet pipe. On a small patch on the partitioning wall between wireless and generator room, immediately beside the spot where two wires, covered with woven fabric, are fed into the adjoining wireless room through a hole in the wall, there are annotations referring to: '6V Batt'(*eries),* 'Alarm Batt'(*eries)* and 'Power Plug' (below).

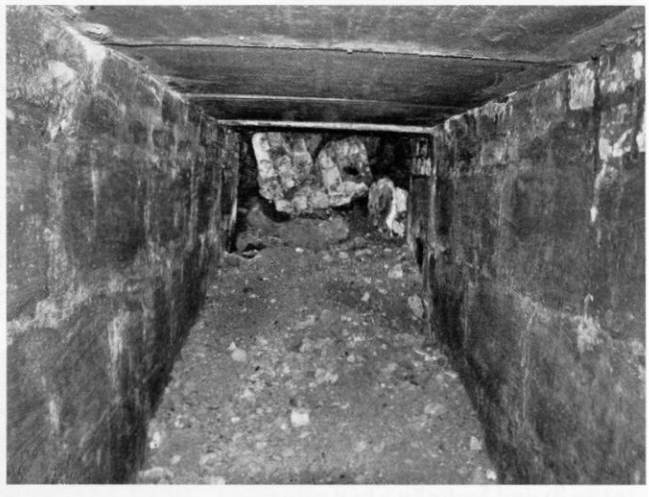


A broken wooden panel was found on the floor of the generator room. This panel would originally have been affixed to the wall with four screws. It has a number of drilled holes through which cables would once have been threaded. Note the pencilled annotation 'Fan and 6V Lighting'. The cable clip seen below the drilled holes presumably held the fan's wire in place. The pencilled annotation 'Power' is yet more evidence of the station having been connected to mains power.

Emergency exit

A square opening in the end wall of the generator room, near the ventilation pipes, leads into the emergency escape tunnel which at Halstead In-Station is an unusually short passage of about ten feet in length, before it is cut short by the slope of the earthen bank it was built into. The opening has retained most of its original timber frame but nothing remains of the cover that would once have sealed it. The passage has a concrete floor, covered with soil and debris.

The walls were constructed from breeze-blocks, with some brickwork filling gaps mainly along the top, and the roof was made from concrete paving slabs. The steep slope the exit opening emerges onto is today heavily overgrown with brambles, making it currently inaccessible. An interior view suggests that the exit opening appears to have been destroyed and/or backfilled. As the true length of the tunnel could not be ascertained due to the collapse it is possible that it may have been somewhat longer than it appears.



Emergency exit tunnel

The site is on private land and was accessed by kind permission of the owner.

Sub Brit member Bob Clary is seen here kitting up for the visit to Southall Borough Control Centre in October. A feature on this Sub Brit visit will appear in *Subterranea* 35 along with this picture.
There's a prize of a Sub Brit bump cap for the best caption to the photo. The winning entry will be printed in the next edition of *Subterranea.*
Entries please to editor@subbrit.org.uk

Fan Bay Deep Shelter, Kent, to be opened to the public

Jon Barker

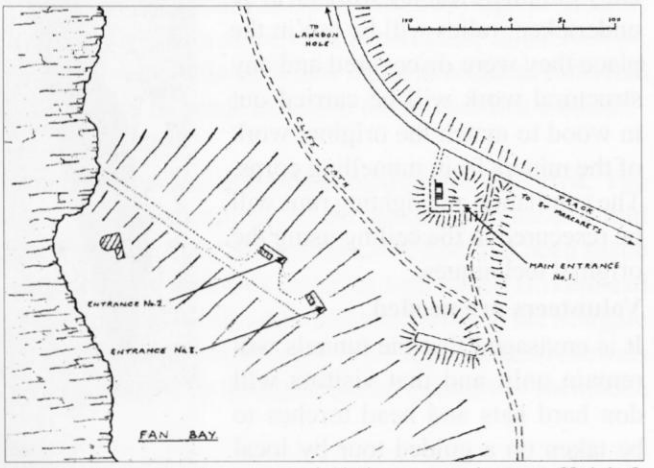
The National Trust had a hugely successful public appeal in 2012 to purchase a large section of the White Cliffs of Dover. In the process they also bought the tunnels system of the Fan Bay battery. The Trust has now begun a project to open the Fan Bay Deep Shelter to the public in 2015.

WWI and WWII coastal defences

Fan Bay is the largest and best-preserved deep shelter of any of the Dover fortifications. It was constructed in the 1940s along with the surface gun battery which was designed to close the English Channel to enemy shipping. The gun battery had three 6-inch guns, an experimental radar system and a plotting room.

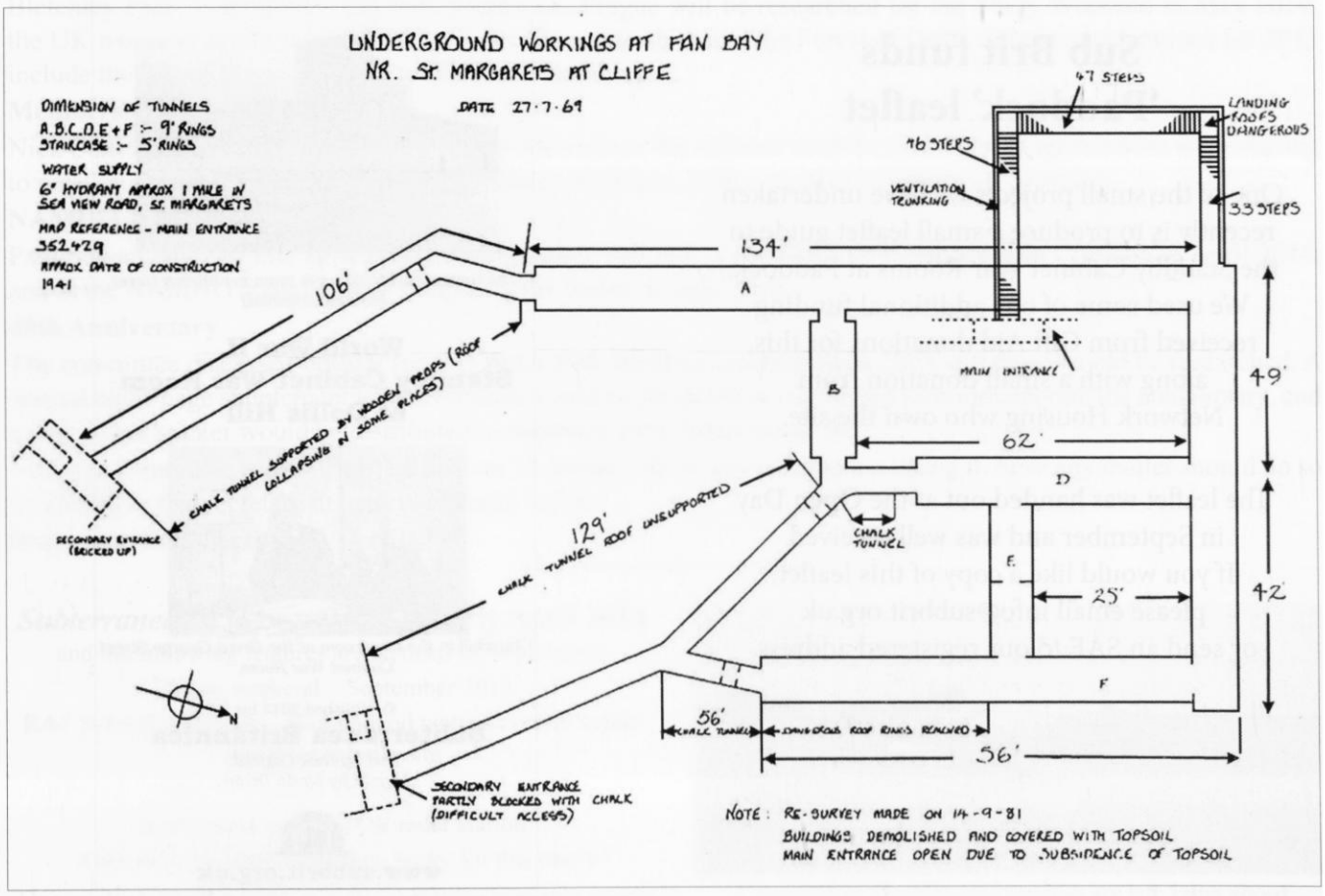
The site is even more intriguing because alongside two of the entrances much earlier sound mirrors from World War I were located. The sound mirrors at Fan Bay worked in conjunction with another set of mirrors located at Joss Bay in north Kent and were the only sound mirrors ever to see service during World War 1.

During the 1970s the surface gun battery, along with many other wartime relics in the Dover area, was cleared during a local 'eyesore' clearance programme. All the surface buildings at Fan Bay were demolished, the tunnel entrances were back-filled and the sound mirrors were buried. Whilst one of the tunnel entrances was reopened some years later, it was so difficult to find that only cavers and committed local historians visited the site which helped the tunnels to remain in good condition.



A recent survey has recorded the extensive graffiti left by the soldiers. Artefacts including an intact needle and thread wedged in the side of the tunnel wall, and a newspaper cutting, have been discovered.

The reopening project is extremely unusual and it must be planned in such a way to mitigate any damage to the nationally important chalk grassland located on the surface. Surface work is planned for late 2014, however significant work has already been started underground and various structural reports, archaeological studies and stabilisation works have taken place. Members of the local Kent Underground Research Group (KURG) including Sub Brit members have been working on site and have helped to clear the first set of stairs of spoil and debris.



The project envisages preserving the tunnels in a raw historical state. Only minimal cleaning works will be undertaken, relics will be left in the place they were discovered and any structural work will be carried out in wood to match the original work of the miners from tunnelling corps. The ventilation and lighting runs will be resecured to the ceiling using the original techniques.

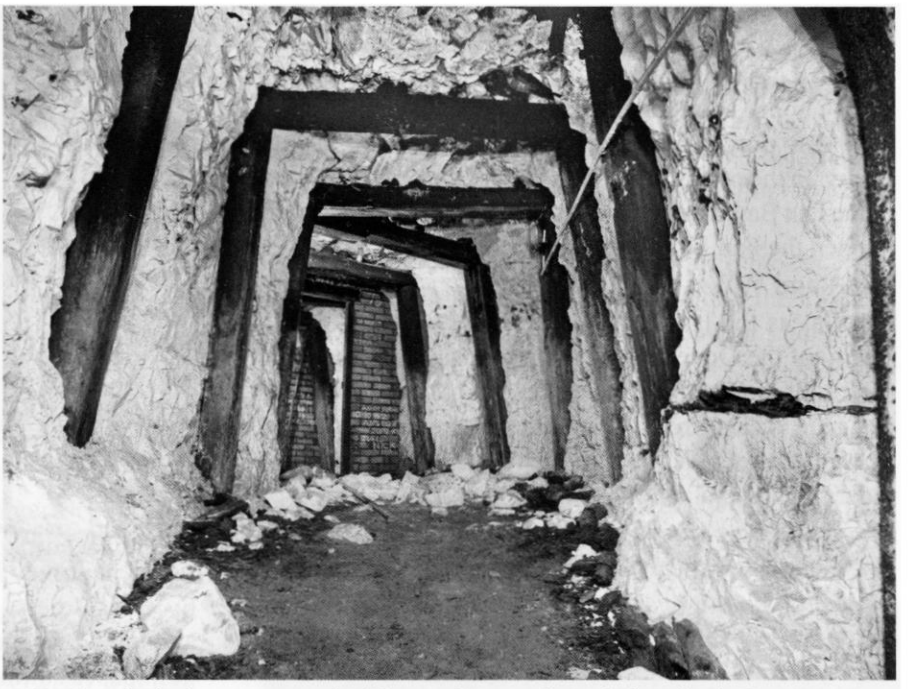
Volunteers are needed

It is envisaged that the tunnels will remain unlit and that visitors will don hard hats and head torches to be taken on a guided tour by local volunteer tour guides. The National Trust plans to reopen the lower tunnel entrances and the tour would also include the sound mirrors.

The project will be mainly run by volunteers and the National Trust is looking for help to get the site ready for 2015 as well as guides to take people underground once the tunnels have been opened.

For more information contact Jon Barker from the National Trust. Jon.barker@nationaltrust.org.uk tel: 0759 978 2943, or visit www.undergroundkent.co.uk/index.php/2013-08-29-00-41-19/deep-shelters/fan-bay-deep-shelter

For information and pictures of a similar battery deep shelter, visit www.subbrit.org.uk/sb-sites/sites/l/lydden_spout_battery/index.shtml

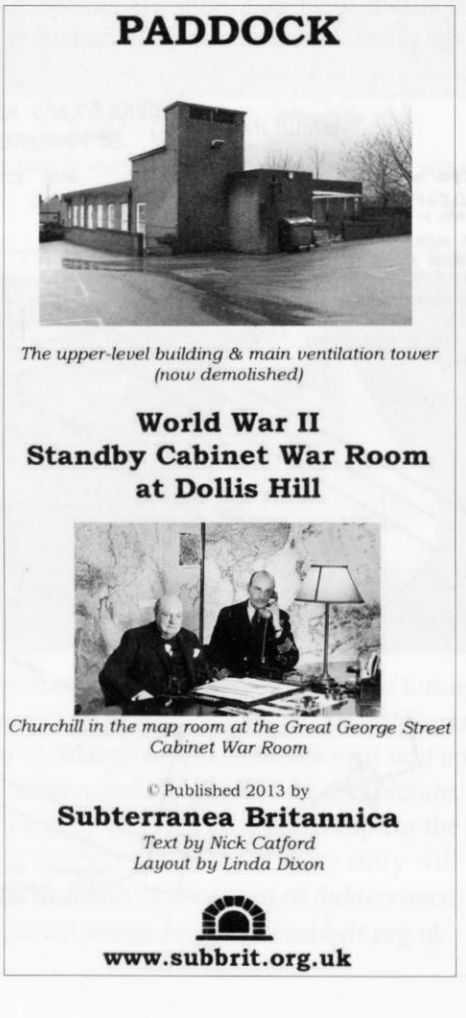


Fan Bay is the best preserved of the gun battery deep shelters in the Dover area. Here unlined chalk tunnels and timber props remain in good condition (1997). Photo Nick Catford

Sub Brit funds 'Paddock' leaflet

One of the small projects we have undertaken recently is to produce a small leaflet guide to the Standby Cabinet War Rooms at Paddock. We used some of our additional funding received from Gift Aid donations for this, along with a small donation from Network Housing who own the site.

The leaflet was handed out at the Open Day in September and was well received. If you would like a copy of this leaflet, please email info@subbrit.org.uk or send an SAE to our registered address.


PADDOCK
The upper-level building & main ventilation tower (now demolished)
World War II
Standby Cabinet War Room
at Dollis Hill
Churchill in the map room at the Great George Street Cabinet War Room
© Published 2013 by
Subterranea Britannica
Text by Nick Catford
Layout by Linda Dixon
www.subbrit.org.uk

Notes of SB Committee Meeting – 12 October 2013

Chairman

Martin Dixon reported that contact had been made by **Sotteranei di Roma,** and a meeting had been arranged in London in November to discuss potential opportunities to work together. The Sub Brit weekend in Devon had been a great success, with 47 members attending; Martin thanked all those involved in the organisation of the visit, in particular Julian Nowill. The visit to Corsham by ten members, selected by ballot, had exceeded expectations. A new incident/accident form had been produced for use by all those involved in organising trips, and would be made available on the Sub Brit website.

Finance

Richard Seabrook reported that the on-line shop was now generating useful additional income for Sub Brit. The committee agreed to explore "registering" Sub Brit as a charity with eBay so that those making purchases could include a donation to Sub Brit. Tony Radstone reported that the first Gift Aid claim using CiviCRM had been made and would now be used for all future claims. Projects being supported by Sub Brit included leaflets for Birkenhead High School; a flyer for Paddock; a secure gate for Blackmoor Mendip Lead Mine; and restoration work at the Margate Shell Grotto. The 2014 membership rates came into force on 01 October and would apply to all applications/renewals received after that date. The committee agreed that indemnity cover should be arranged for all committee members, as part of the Sub Brit insurance cover.

WebSite

Richard Seabrook reported that CiviCRM was now fully operational, and making the processing of membership applications a lot more efficient. The committee congratulated Richard on the successful management and implementation of the project. Richard said that, in due course, work would start on the development of a Members' Forum and to enable event bookings.

Subterranea

Nick Catford reported that the 'Corsham Special' (*Subterranea* 22) had now been reprinted and all outstanding orders would be fulfilled in the near future. The magazine would be highlighted on the Sub Brit website. Potential cost savings in the production of *Subterranea* are being pursued.

Meetings & Visits

Chris Rayner reported that all arrangements for the Autumn Meeting had been finalised, and those for Spring 2014 were on track. It is planned to hold Autumn Meeting 2014 in the Newcastle area, on similar lines to last year's visit to Liverpool. There have been successful visits to Cuckfield ROC, Gravesend, Reigate and Southall. The visit to Portland/Ridgeway, run as an Open Day in May, was very successful.

A number of other potential sites for day-visits were being considered, including Scout Mine, Box Stone Mines, Bletchley Park, Fort Widley and Fort Southwick. Prague will be researched for the Study Weekend in May 2014; the UK weekend for 2014 was likely to be in Gloucestershire and the Forest of Dean. Other considerations for 2015 include the Isle of Wight, Guernsey, Rome and Hamburg.

Membership

Nick Catford reported that, after the usual slowdown over the summer months, membership applications were starting to pick up. Currently, Sub Brit had 1084 ordinary members, with a number of others yet to renew.

NAMHO & SERIAC

Paul Sowan reported that he would be representing Sub Brit at the SERIAC Conference in Croydon in April 2014, and at the NAMHO conference in Bangor, north Wales, in July 2014.

40th Anniversary

The committee discussed options for Sub Brit's 40th Birthday celebration in 2014 and these would be researched. A special eight-page supplement to *Subterranea* would be produced in the Spring to commemorate the anniversary, and a special car sticker would be distributed to members with *Subterranea* 34.

The next committee meeting will be held on 18 January 2014; any members wishing to raise any matter should do so in writing to the Secretary at least two weeks before.

Roger Starling, Secretary

Subterranea 35 to be published early April 2014

and the following features are planned to be included.

Devon weekend – September 2013

RAF North Luffenham – Bloodhound tactical control centre and Thor missile site

Visit to Southall Borough Control

RAF Ventnor – ROTOR radar station

A return to Alderney (3rd time lucky for this one!)

One or more might be held over depending on available space

A number of Bloodhound missiles are left 'lying about' at RAF North Luffenham. Photo Nick Catford

57
10
VIGGEN
Klättra in i Viggen